2005 Trial
Effect of boron fertilizer applications on grapevine pruning wounds on bud break, boron tissue levels and vine yield

Rhonda Smith
UC Cooperative Extension, Sonoma County

Research by Philippe Rolshausen and Doug Gubler, UC Davis Plant Pathology, has shown that 5% boric acid (17.5% a.i. boron) mixed with a commercial paste and applied to pruning wounds can control Eutypa dieback in grapevines. They reported that bud failure sometimes occurred in the node below the treated wound at the spur tip. Boron fertilizer is a convenient replacement for boric acid yet it has not been evaluated for phytotoxicity when applied to recently pruned vines. A trial conducted in 2005 in Sonoma County monitored the effect of commonly used rates of boron fertilizer applications on bud break, vine tissue B concentrations and yield.

Trial Description

Trials were established January 2005 in two blocks of Chardonnay vines. Trial 1 was in a block planted in 1973 on 8'x12' spacing with a quadrilateral cordon training system. Vines had 21 to 28 spurs. Trial 2 was in a block planted in 1987 on 6'x10' spacing with a vertical shoot positioned bilateral cordon training system and each vine had 10 to 14 spurs. Vines in Trial 1 were pruned 14 January and in Trial 2 on 24 February 2005.

Different rates of a liquid boron fertilizer product (guaranteed analysis 10% boron; contains 132 g boron/Liter) were applied to all pruning wounds as either spray or paste applications with the exception of untreated control vines. The rates were identical to those in use by some growers during winter 2004-05. Spray treatments were applied using a pressurized spray bottle at a rate equivalent to 30 GPA. Paste treatments were applied by hand with a brush and were a mixture of fertilizer and commercial paste (Doc Farwell's Seal & Heal). Paste was applied to all pruning wounds, including the ends of two-bud spurs.

Fertilizer treatments were applied on the same day that vines were pruned. Each trial was a randomized complete block design with 6 treatments and 4 replications. Single vine and 3-vine replicates were used in Trial 1 and Trial 2 respectively.

Treatments:

5% fertilizer solution (0.5% Boron); spray application [6600 ppm B] [1]
50% fertilizer solution (5% Boron); spray application [66000 ppm B]
5% fertilizer in paste (0.5% Boron); paste application [6600 ppm B]
50% fertilizer in paste (5% Boron); paste application [66000 ppm B]
1% fertilizer solution (1% Boron); spray application [1320 ppm B]
Control

[1] 50ml of product was mixed in 950 ml water to make 1 Liter of 5% fertilizer solution. That 1 Liter solution contains 6.6g Boron (because 50ml of product contains 6.6g Boron).
6.6g B/Liter = 6600mg B/Liter = 6600 ppm B

Data collected

Bud Break. The modified E-L System was used to describe stages of shoot growth from node positions on each spur [Coombe, B.G. (1995), Adoption of a system for identifying grapevine growth stages. Australian Journal of Grape and Wine Research 1, 104-110]. The basal, first and second node positions on all spurs on each vine were assigned an E-L number on 1 April and 11 April for Trial 1 and 2 respectively. On 1 April, the majority of the nodes in the untreated vines in Trial 1 were at E-L stages 9 to 12 (shoot lengths ranged from 2-10 cm and a maximum of 5 leaves had separated from the shoot tip). On 11 April the majority of the nodes in the untreated vines in Trial 2 were at E-L stages 9 to 13 (shoot lengths slightly longer and up to 6 leaves had separated from the shoot tip). A bud was determined to have reached bud break when its E-L number was ≥4. Percent bud break was calculated by node position for each vine.

Boron Concentration. Elemental B concentration was found in tissue collected on three sample periods. The first period was 7 April and 11 April in Trials 1 and 2 respectively and is reported in the results as the "bud break" sample period. On those dates, untreated vines had 80% bud break. Petioles and blades were combined to provide enough material for analysis. At bloom and veraison, petioles and blades were collected separately. Bloom samples were collected from Trials 1 and 2 on 23 May and 27 May respectively when average percent bloom for each trial was about 80%. Veraison samples for both trials were collected on 4 August.

Fruit Maturity and Yield. Prior to harvest, berry samples were collected on two dates from each trial and berry weight, brix, TA and pH were found. Vine yield data (cluster number and total crop weight per vine) were collected at harvest on 29 and 30 September.

Results and Discussion

Percent bud break was significantly affected by boron fertilizer rate (boron concentration) in both trials. The application method (spray vs. paste) did not affect bud break differently. Boron concentration affected bud break differently in the three node positions on each spur (Table A). When just the basal nodes are considered, the greatest percent bud break occurred in the two treatments with the highest boron concentration (66000 ppm spray and paste applications). These treatments also affected bud break in nodes 1 and 2 however with the opposite effect. When nodes 1 and 2 are considered separately, the applications with the highest boron concentration resulted in the lowest percent bud break. Node 2 (the node immediately below the cut surface of the spur) was most affected. Average percent bud break of node 2 was 56% to 58% in vines that received the spray and paste applications of 66000 ppm B. Bud break in the same node for all other treatments including the control ranged from 95% to 99% thus was not affected by applications of lower concentrations of boron (1320 ppm and 6600 ppm B).

In general, the analysis of tissue collected at bud break and bloom for boron level indicated that the highest boron concentration (66000 ppm) applied as a spray led to higher concentration of B in the tissues. At bloom, petiole tissue from vines that had received the highest concentration of applied boron averaged 58 and 54 ppm B in Trials 1 and 2 respectively. All B levels in petiole tissue from vines that received other treatments were lower and not different from each other. As expected, boron levels were elevated in the blades as compared to the petioles, however the relative differences among treatments were similar to the petiole results. The 66000 ppm boron spray resulted in an average of 120 and 96 ppm B in blades at bloom in Trials 1 and 2 respectively whereas the untreated vines in those trials averaged 58 and 67 ppm B (Table B). Spray applications of 66000 ppm boron resulted in higher B concentration in blade tissue at bloom than did paste applications at the same rate.

At veraison, there were no treatment differences in B concentration in petioles collected from Trial 2. Boron concentration in blades from that trial averaged 137 ppm B in vines that received applications of high concentration of boron spray, but this was not significantly different than B concentration in blades of the untreated control vines (Table B). In Trial 1, both B concentration in petioles and blades were higher only in the vines that received the 66000 ppm boron spray application. That treatment had an average level of 146 ppm B in the blades and the control averaged 88 ppm B.

No symptoms of foliar boron phytotoxicity were seen in either trial at any time during the 2005 season. In general, Trial 2 tended to have higher B levels in vine tissue at all 3 sample periods, regardless of treatment as compared to Trial 1. This underscores the importance of knowing baseline tissue B levels for each block prior to applying boron fertilizer on pruning wounds.

Berry sample data indicated a high degree of variability from vine to vine in each trial. Vine age and variable shoot numbers may have been responsible. As a result, conclusions cannot be made about the treatment effect on berry weight or composition.

Yield was not affected by applications of boron fertilizer on pruning wounds (Table C). There was no difference in the total clusters per vine in Trial 1 or average clusters per vine in Trial 2. Also average cluster weights were the same across all treatments within each trial. Although bud break of node 2 was reduced by the highest concentration of applied boron, that treatment did not result in less crop per vine. The basal nodes in those vines had significantly higher bud break and the clusters produced on basal shoots had a compensating effect on yield.

Summary

- ☼ In both trials, high concentration of boron (66000 ppm) applied to pruning wounds resulted in the lowest percent bud break in node 2 (the node immediately below the cut surface of the spur) and the highest percent bud break in the basal node. Bud break in all nodes in vines that received applications of lower concentrations of boron (1320 ppm and 6600 ppm) was the same as in the untreated control vines.

- ☼ In both trials, high concentration of boron spray contributed to increased boron in vine tissues and lower concentration boron applications (spray or paste) did not cause an increase in B found in vine tissues.

- ☼ Trial 2 tended to have consistently higher concentrations of B found in vine tissues of all treated vines, including the control, compared to vines in Trial 1. This difference was likely caused by different baseline vine boron concentration at each trial site and not by a time (pruning-application) or treatment effect.

- ☼ Yield was not affected by treatment. There were no differences among the treatments in either total or average clusters per vine. Within each trial, average cluster weight was nearly the same regardless of treatment. In vines that received 66000 ppm boron applications, an increase in fruitful basal shoots compensated for the reduced shoot number from count node positions.

Effect of boron fertilizer application on pruning wounds in January on same year A) Percent bud break by spur node; B) Boron concentration in blades at bloom; C) Yield per vine

A. Percent bud break by spur node (Trial 1 & 2 combined)[a]

	Basal node		Node 1		Node 2	
Treatment	mean[b]	sd	mean	sd	mean	sd
6600 ppm spray	53 ab	0.17	97 b	0.05	95 b	0.08
66000 ppm spray	68 c	0.13	85 ab	0.16	58 a	0.23
6600 ppm paste	40 a	0.08	97 b	0.04	99 b	0.02
66000 ppm paste	66 c	0.13	79 a	0.27	56 a	0.26
1320 ppm spray	47 ab	0.09	94 b	0.09	96 b	0.05
control spray	45 ab	0.14	94 b	0.03	99 b	0.03
	p = 0.0001		p = 0.0394		p = 0.0000	

[a]Percent bud break calculated from E-L numbers (see text). Trial 1 was evaluated on 1 April and Trial 2 on 11 April 2005.

[b]Values within a column followed by a common letter are not significantly different (95% Tukey's HSD).

B. Boron concentration (ppm):

	Blades at Bloom[a]				Blades at Veraison[b]			
	Trial 1		Trial 2		Trial 1		Trial 2	
Treatment	mean	sd	mean	sd	mean	sd	mean	sd
6600 ppm spray	61 a	4	68 a	15	82 a	10	108 ab	11
66000 ppm spray	120 b	42	96 b	18	146 b	5	137 b	19
6600 ppm paste	69 a	12	68 a	5	90 a	12	105 a	9
66000 ppm paste	58 a	2	77 ab	6	88 a	25	111 ab	18
1320 ppm spray	60 a	9	70 a	12	81 a	14	97 a	14
control spray	58 a	7	67 a	6	88 a	25	111 ab	11
	p = 0.0001		p = 0.0135		p = 0.0002		p = 0.0166	

[a]Bloom sample dates: 23 May and 27 May 2005 for Trial 1 and Trial 2 respectively.

[b]Veraison sample date: 4 August 2005 for both trials.

C. Total yield per vine (pounds)[a]

	Trial 1		Trial 2	
Treatment	mean	sd	mean	sd
6600 ppm spray	45.7	9.9	15.9	4.5
66000 ppm spray	32.2	12.0	12.2	3.2
6600 ppm paste	48.9	12.6	13.9	3.4
66000 ppm paste	30.8	10.2	8.7	4.8
1320 ppm spray	47.3	6.8	17.1	7.8
control	45.0	13.7	15.2	4.0
	p = 0.1270		p = 0.1460	

[a]Trial 1 harvested 30 September 2005 (8'x12'; quadrilateral cordons).

Trial 2 harvested 29 September 2005 (6'x10'; bilateral cordons).