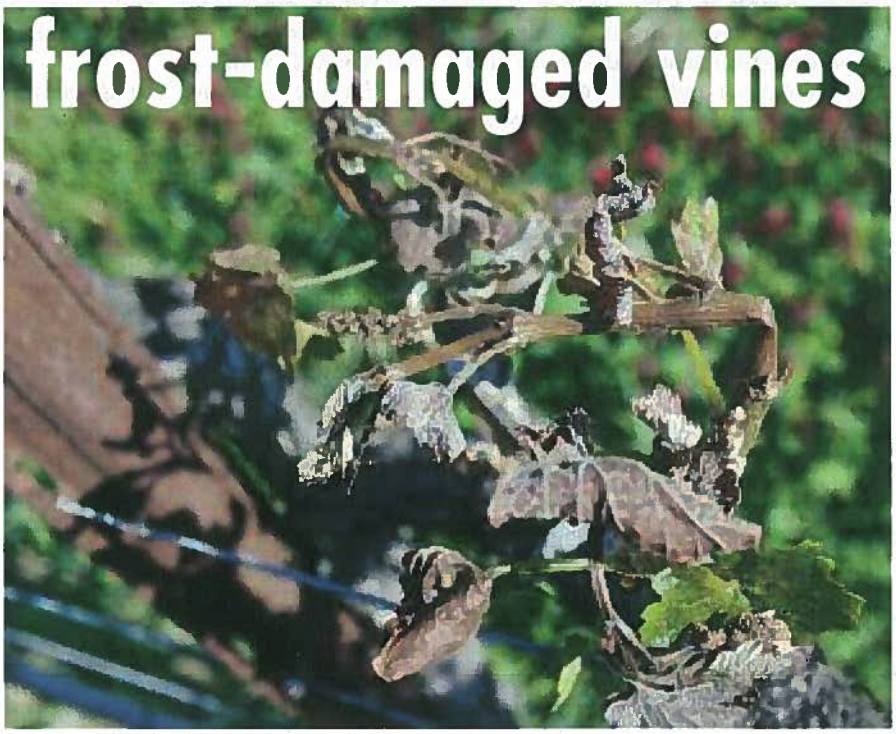
Managing frost-damaged vines



[Top] Frost protection, spring 2008. Photo by Steve Sterling of Esterlina Vineyards. [Bottom] Shoots damaged by frost, spring 2008.

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There is nothing sadder to most growers than looking at their vineyard following a damaging frost in the spring, unless it is a frosted vineyard in the fall before they pick the ripening fruit.

Green grapevine tissue is damaged whenever temperatures fall below 32°F for longer than 20 minutes. In spring, emerging shoots contain developing flowers that are very prone to freezing damage.

The spring of 2008 was one of the most difficult frost seasons in many years for growers on the North Coast of California, with numerous nights of low temperatures and low dew points. Normally, **radiant freezes**, in which the air is stratified and only vineyards planted on the lowest areas of the landscape experience freezing, are common.

On the evening of April 20, a large cold air mass created **advective freezing** conditions, and many vineyards were damaged; since there was no temperature stratification, no matter where a vineyard was on the landscape, it was exposed to freezing temperatures. In this frost event, upland vineyards that normally are above cold stratified air were damaged.

Because of the low dew points, temperatures dropped rapidly, and even some vineyards that were frost-protected with sprinklers incurred injury because the systems were turned on at too low a temperature considering the low dew points. In these low-humidity conditions, evaporative cooling of the water that was applied actually cooled the vineyards to below freezing temperatures instead of protecting them.

Growers often wonder if there is an advantage to immediately pruning damaged shoots to stimulate secondary buds that might flower and set a smaller crop. Some varieties tend to do this on their own, such as Pinot Noir, Arneis, and Zinfandel. Since the potential for harvest-income is limited following a severe frost, some growers do minimal maintenance in the vineyard, primarily suckering the trunks and controlling powdery mildew. In this study, we looked at different ways of treating damaged vines to stimulate new shoot development.

Materials and Methods

Two sites were chosen: a Chardonnay vineyard (CTPS #96 on 101-14 rootstock) planted on a 7 foot x 8 foot spacing (778 vines per acre) along the Russian River in deep soil (Russian River loam) in Hopland, and a Cabernet Sauvignon (CTPS Clone 337 on 1103P rootstock) vineyard on an

upland site above the Ukiah Valley planted on a 5 foot x 8 foot spacing (1,089 vines per acre) in shallow soil (Redvine clay loam).

On the night of the April 20, 2008 freeze, damaged shoots in the Chardonnay vineyard had emerged about four inches in length, and shoots in the Cabernet Sauvignon vineyard had emerged about two inches in length.

Treatments were as follows:

- Control, in which the vines were left alone for dormant buds to emerge;
- Damaged shoots were removed by hand by breaking them from the spurs;*
- Damaged shoots were removed by cutting back to the base where current season tissue is connected to the previous season's woody tissue; and
- Whole spurs* were removed along with the damaged shoots to encourage basal buds to sprout in the spur position.

*NOTE: A "spur" is the basal node of the previous year's woody growth containing two buds.

A randomized complete block experimental design consisted of the four treatments replicated four times. In the Chardonnay trial, each replication consisted of 10 vines (40 vines per treatment), with a total of 160 vines in the trial. In the Cabernet Sauvignon trial, each replication consisted of 6 vines (24 vines per treatment), with a total of 96 vines in each experiment.

Treatments were applied to the Chardonnay vines on May 2, 2008. Treatments were applied to the Cabernet Sauvignon vineyard on May 13, 2008.

Since there was so little fruit in both vineyards, minimal cultural practices were performed, mostly consisting of sulfur dusting to prevent powdery mildew. No canopy management practices were applied.

In the Cabernet Sauvignon trial, emerging buds were removed between the spurs on the cordons of vines receiving treatments in a time-motion study. The workers were monitored as they applied the treatments to determine how much time each treatment would take on a per-vine basis. An average time needed to apply the treatment to one vine was then multiplied by the number of vines per acre, to arrive at a per-acre time for each treatment.

At harvest, clusters were counted, cut, and weighed for all vines in each replication. One hundred berry samples were taken randomly from each replication and analyzed for Brix, titratable acidity, and pH.

The Chardonnay plot was harvested on September 30, 2008. The surrounding Chardonnay vineyard was not commercially harvested. The Cabernet Sauvignon plot was harvested on October 29, 2008, and the surrounding vines were commercially harvested.

Following leaf-fall, spur positions were counted, along with stems on the vines.

Results

In the Chardonnay trial, there were some significant differences in vine performance between treatments (at the .05 confidence interval). (Table I)

Fruit quality for the Chardonnay plot was not statistically significant between treatments. (Table II)

Shoot emergence and regrowth results from the Chardonnay plot are shown in Table III.

For the Cabernet Sauvignon plot, Table IV has the results. There were no statistical differences between treatments, but there was a definite trend toward improved yield with post-frost damage manipulations. In reviewing the statistics, the response to the treatments was quite variable, resulting in a high standard deviation for the treatments.

Fruit chemistry was not significantly different between treatments for the Cabernet Sauvignon.

Shoot emergence and regrowth from the Cabernet Sauvignon plot are shown in Table V.

Table VI shows data measured in the time study in the Cabernet Sauvignon plot.

Conclusions

Yields generally were increased by removing damaged tissue from the spurs, no matter which technique was used. In treated Chardonnay vines, the yield was significantly

Table I. Chardonnay: Harvest Statistics

Treatment	Avg. Cluster Weight (g)	HG*	Avg. Cluster Count	HG*	Avg. Yield/Vine (Kg)	HG*	Avg. Yield/Acre (tons)	HG*	% Change from Control
Control	42.34	a	162.00	a	0.65	a	0.56	a	—
Break Damaged Shoots	47.52	a	218.75	ab	1.04	b	0.90	b	60%
Cut Spurs	47.44	a	241.00	bc	1.14	bc	0.97	bc	74%
Cut Damaged Shoots	45.12	a	307.25	c	1.39	c	1.19	c	112%

Table II. Chardonnay: Chemistry

Treatment	Berry Weight (g)	HG*	Brix	HG*	pH	HG*	Titratable Acidity (grams/100cc)	HG*
Control	0.98	a	20.7	a	3.6	a	0.91	a
Break Damaged Shoots	1.03	a	21.1	a	3.6	a	0.91	a
Cut Spurs	0.98	a	20.7	a	3.6	a	0.91	a
Cut Damaged Shoots	1.06	a	21.2	a	3.6	a	0.88	A

Table III. Chardonnay: Shoot emergence and regrowth

Treatment	# of Spur Positions Per Vine	HG*	# of New Shoots on Spurs	HG*	New Shoots on Cordons	HG*
Control	13	a	5.60	a	22	a
Break Damaged Shoots	13	a	3.15	b	35	c
Cut Spurs	12	a	8.70	c	30	b
Cut Damaged Shoots	13	a	8.70	c	36	C

*Values followed by the same letters are in homogeneous groups

Table IV
Cabernet Sauvignon frost damage management trial: Time study

Treatment	Average Time to Prune Damaged Vines (seconds)	Total Hours per Acre (projected)
Control	0 (no pruning)	0
Break Damaged Shoots	66	20
Cut Spurs	84	25.4
Cut Damaged Shoots	91	27.5

Table V: Cabernet Sauvignon: HARVEST STATISTICS

Treatment	Avg. Cluster Weight (g)	HG*	Avg. Cluster Count	HG*	Avg. Yield/Vine (Kg)	HG*	Avg. Yield/Acre (tons)	HG*	% Change from Control
Control	54.5	a	19	a	1	a	0.86	a	—
Break Damaged Shoots	60.7	a	22	a	1.3	a	1.11	a	30%
Cut Spurs	60.4	a	21	a	1.2	a	1.03	a	20%
Cut Damaged Shoots	63.1	a	21	a	1.3	a	1.11	a	30%

Table VI: Cabernet Sauvignon: CHEMISTRY

Treatment	Berry Weight (g)	HG*	Brix	HG*	pH	HG*	Titratable Acidity (grams/100cc)	HG*
Control	0.98	a	27.0	a	3.6	a	0.73	a
Break Damaged Shoots	1.03	a	26.9	a	3.6	a	0.72	a
Cut Spurs	0.98	a	27.0	a	3.6	a	0.73	a
Cut Damaged Shoots	1.06	a	26.7	a	3.6	a	0.74	a

Table VII: Cabernet Sauvignon: SHOOT EMERGENCE AND REGROWTH

Treatment	# of Spur Positions Per Vine	HG*	# of New Shoots on Spurs	HG*	New Shoots on Cordons	HG*
Control	11	a	1.30	a	16	a
Break Damaged Shoots	11	a	1.70	a	18	b
Cut Spurs	11	a	1.80	a	18	b
Cut Damaged Shoots	11	a	3.40	b	19	B

***Values followed by the same letters are in homogeneous groups**

higher than in the control, with vines responding the most when damaged tissue was cut to the base of the shoot, but retaining a small amount of the current year's tissue. In the Cabernet Sauvignon plot, there were no significant differences between treatments, but there was definitely a trend towards higher yield when damaged shoots were trimmed.

Evidently there are bud primordia or dormant buds that then grow — there were significantly higher stem numbers on the spur positions in the treatment in which we cut damaged shoots, as well.

Treatment consisting of breaking damaged new growth off by hand.

We did not differentiate in the study where the stems had actually emerged on the spur positions. Doubtless some of the shoots arose from dormant buds beneath the previous year's wood on older tissue (2+ years).

Fruit chemistry was not significantly different between the treatments. The Chardonnay sugar levels were quite low considering the time of harvest. Most of the undamaged Chardonnay blocks in the area were harvested by September 20 at much higher yields and sugars (a goal of 23.5° Brix). Even though there was some production on the vines that had been frozen, ripening was quite delayed, well below the commercial sugar content target.

The Chardonnay trial block was not commercially harvested as there was so little fruit present. By contrast, Cabernet Sauvignon grapes reached maturity in our trial, and the block was commercially harvested.

Despite the cost, most growers might do canopy manipulation after a frost specifically in order to ensure good strong wood to prune to for the following year.

Whether it makes sense to do any manipulations following freezing is questionable, and depends on the variety and need for the particular fruit.

Cut damaged tissue and one-year-old wood off of spur with shears, to stimulate basal buds.

Given the extra labor expense and the relatively low yield, most growers would not see this as a cost-effective practice. The only exception might be for a particularly valuable fruit, such as a variety needed for an estate-based wine program.

The average yield of the Chardonnay block in our study is 3.9 tons per acre in most years. The average yield of the Cabernet Sauvignon block in our study is 3.6 tons in most years. The remainder of the Cabernet

Treatment consisting of cutting damaged shoots with shears, leaving basal green tissue

Sauvignon block was harvested in 2008, as the fruit is quite valuable, with a yield of 1.1 tons per acre.

This research represents only one year of data. More research is needed to see if these treatments are effective in other situations and with other varieties. We hope that opportunities to continue this work rarely occur! ■

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