Response of 'Himrod' Grapevines to Cane Girdling

Thomas J. Zabadal¹

Cooperative Extension Service, Cornell University, 110 Court Street,
Penn Yan, NY 14527

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Abstract. The effect of cane girdling, in combination with the common commercial practices of gibberellic acid applications and/or other crop control, on vine size and fruit characteristics was measured over 3 years for 'Himrod' grapevines (*Vitis × labruscana* × *V. vinifera*) grown in central New York state. Cane girdles 4 mm wide between the second and third node from the base of each fruiting cane resulted in vines that were capable of sustaining vine size while enhancing several aspects of fruit quality. When added to several vine-manipulation regimes, cane girdling increased cluster weight as much as 106%, berries per cluster as much as 138%, and berry weight as much as 17%. Although cane girdling increased yield as much as 66%, it consistently reduced fruit soluble solids concentration (SSC). Therefore, for cane girdling to contribute to sustained production of quality 'Himrod' table grapes in a cool-growing-season climate, it will be necessary to practice it in combination with a level of crop control that will ensure acceptable fruit SSC.

First practiced on grapevines in 1745 (Husmann, 1898), girdling has been found to increase berry weight (Harrell and Williams, 1987; Jacob, 1928; Weaver, 1955) and set (Jacob, 1931; Lider and Sanderson, 1959) and to advance fruit maturity (Jacob, 1928; Weaver, 1955). However, the benefits of girdling are often obtained at the expense of vine vitality, which results from disrupted translocation to trunk and root tissues, as well as from reduced assimilation rate of leaves apical to the girdle (Hofacker, 1978; Kriedemann and Lenz, 1972). Although partial girdling might be less debilitating to vine size than complete girdling, it is inferior for increasing berry weight (Jensen et al., 1976). The width of cane girdles used commercially averages 4.8 mm (Winkler, 1962). The optimum time for girdling to cause an increase in berry weight is immediately after shatter (Winkler, 1953).

Over the past 40 years many seedless table grape cultivars have been released for use in relatively cool-growing-season climates like the Finger Lakes region of New York, which has a long-term growing-degree-day accumulation (base 10C) of ≈ 1450 (New York Climate, 1991). However, a lack of suitable cultural practices to include girdling has limited

commercialization of these cultivars. This study, therefore, was undertaken over 3 years to determine the effects of cane girdling on vine size and fruit quality of 'Himrod' table grapes when it was applied a) in a relatively narrow band, b) at the optimum time for increasing berry weight, and c) in combination with gibberellic acid sprays and crop control.

Mature ($\approx$ 11-year-old) 'Himrod' grapevines, planted on a 2.7 m (row) $\times$ 2.1 m (vine) spacing, were balance-pruned to retain 25 nodes for the first 0.45 kg of cane prunings and 10 nodes for each additional 0.45 kg of cane prunings. A maximum of 55 nodes was retained per vine. Vines were trained to the umbrella Kniffin system and pruned to $\approx$ 12-node fruiting canes. Cane pruning weights were recorded for each vine at the beginning (1982) and after each of the 3 years (1983-85) of the experiment. At harvest, 12 clusters were randomly chosen from each vine and weighed. Six of those clusters were analyzed for number of berries per cluster, berry weight, and soluble solids concentration (SSC).

Crop control and gibberellic acid sprays are typical commercial practices when growing 'Himrod' in the Finger Lakes. Crop control, either flower cluster thinning (FCT) or cluster thinning (CT), is essential in the Finger Lakes climate to limit crop size and ensure acceptable fruit maturity. Therefore, one experiment was designed to evaluate the effects of cane girdling when applied in combination with FCT alone and another experiment was designed to evaluate cane girdling when performed in combinations with CT, FCT, and gibberellic acid (GA₃) sprays.

The first experiment was a randomized complete-block design with five replications. Each experimental unit consisted of a three-vine plot. The three treatments consisted of a control, FCT, and FCT plus cane girdling (G). Treatments were applied to the

same vines for each of three consecutive years (1983-85).

The second experiment was also a randomized complete-block design with five replications and three-vine experimental units. The seven treatments were as follows: 1) control; 2) FCT and GA₃ sprays; 3) FCT, GA₃ sprays, and G; 4) CT; 5) CT and G; 6) CT and GA₃ sprays; and 7) CT, GA₃ sprays, and G. At early berry shatter, when berries averaged 4 mm in diameter, cane girdles 4 mm wide were made with a commercially available cane-girdling tool between the second and third basal nodes of fruit canes. Flower cluster thinning involved removing all but the basal cluster from each shoot before the start of bloom. Cluster thinning was performed in the same manner at early berry shatter. Clusters on shoots basal to the girdles were removed at the time of cane girdling because they would not be influenced by girdling. Wind and other mechanical damage during the growing season contributed to fewer clusters at harvest than originally retained with FCT. Gibberellic acid was applied-with a backpack sprayer to clusters to runoff when 50% of florets were open (20 mg-liter⁻¹) and again at early berry shatter (50 mg-liter⁻¹). Similar results were obtained for all three harvests. However, bird and raccoon depredation of portions on the crop at harvest in the first 2 years resulted in incomplete yield data. Therefore, yield data are presented only for the 3rd year of the experiment, when netting and electric fencing allowed collection of a complete yield data set.

Analysis of variance was computed for cane pruning weight, berry weight, number of berries per cluster, cluster weight, SSC (percent) of the fruit, and total yield per vine. Comparisons of treatments were made by orthogonal contrast using F tests.

In the first experiment, vines subjected to FCT and girdling produced an average of 1.13 kg of cane prunings per vine per year. Although a significant year effect was measured for cane pruning weight ($P < 0.005$), there was no significant treatment $\times$ year interaction ($P < 0.42$) or treatment effects within each year ($P < 0.47, 0.64$, and 0.95 for 1983, 1984, and 1985, respectively). For vines that had been FCT, girdling significantly increased berry weight, number of berries per cluster, and cluster weight over those that had not been girdled (Table 1). The FCT and girdling treatment produced the heaviest berries, the largest number of berries per cluster, and the heaviest cluster weight of the three treatments. These changes in fruit characteristics, resulting in part from girdling, are desirable because they enhance the marketability of the fruit.

All vines in the second experiment averaged 1.03 kg of cane prunings at the start of the experiment. Although a significant year effect was measured for cane pruning weight, $P < 0.001$, there was no significant treatment $\times$ year interaction ($P < 0.45$) or treatment effect within each year ($P < 0.43, 0.78$, and 0.94 for 1983, 1984, and 1985, respectively). There was also no significant effect

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¹Associate Professor. Present address: Dept. of Horticulture, Michigan State Univ., East Lansing, MI 48824.

Table 1. Berry weight, berries per cluster, and cluster weight for 'Himrod' grapevines that were not manipulated, flower cluster thinned, or flower cluster thinned and cane girdled. Data for the 1985 growing season.

Treatment ^a	Berry wt (g)	Berries/cluster (no.)	Cluster wt (g)
C	2.07	92	184
FCT	2.10	108	235
FCT + G	2.32	2.58	365
Contrasts			
C vs. FCT & FCT + G	**	***	***
FCT vs. FCT + G	***	**	***

^aC = Control; FCT = flower cluster thinned to one cluster per shoot before anthesis; G = cane girdle of fruiting canes between basal nodes two and three when berries averaged 4 mm in diameter.

***, ** Significant at $P = 0.01$ or 0.001 , respectively.

Table 2. Berry characteristics, yield and fruit soluble solids concentration (SSC) for 'Himrod' vines subjected to combinations of flower cluster thinning, cluster thinning, gibberellic acid, and cane girdling. Data for the 1985 growing season.

Treatment ^a	Berry wt (g)	Berries/ cluster	Cluster wt (g)	Yield (kg/vine)	SSC (%)
C	1.92	88	177	6.6	19.7
FCT + GA	2.22	121	270	6.9	19.8
FCT + GA + G	2.37	183	446	10.5	17.9
CT	2.02	103	204	6.3	19.8
CT + G	2.37	181	421	10.5	18.1
CT + GA	2.20	124	271	7.4	19.8
CT + GA + G	2.41	207	500	10.5	17.6
Contrasts					
C vs. FCT + GA & FCT + GA + G & CT & CT + G & CT + GA & CT + GA + G	***	***	***	*	**
FCT + GA & FCT + GA + G vs. CT + GA & CT + GA + G	NS	NS	NS	NS	NS
CT & CT + G vs. CT + GA & CT + GA + G	*	NS	*	NS	NS
CT vs. CT + G	***	***	***	***	***
CT + GA vs. CT + GA + G	**	***	**	**	***
FCT + GA vs. FCT + GA + G	*	***	***	**	***

^aC = Control; FCT = flower cluster thinned to one cluster per shoot before anthesis; GA = gibberellic acid sprays at midbloom and berry shatter; G = cane girdling of fruiting canes between basal nodes two and three when berries averaged 4 mm in diameter; CT = cluster thinned to one cluster per shoot at berry shatter.

NS, ***, ** Nonsignificant or significant at $P = 0.05$, 0.01 , or 0.001 , respectively.

on cane pruning weight for any contrast for the 4 years (1982-85). Cane girdling, when performed in conjunction with CT, with CT and GA, sprays, or with FCT and GA, resulted in significant increases in berry weight, berry count per cluster, cluster weight, and total yield per vine (Table 2). However, the addition of cane girdling to these three vine manipulation regimes resulted in highly significant decreases in fruit SSC (percent) (Table 2).

Yield components were similar when flower cluster thinning was combined with either GA, applications alone or with GA, and cane girdling (Table 2). The lack of a significant difference between FCT and CT for all variables measured is likely due to the timing of the cluster thinning at early berry shatter. Cluster thinning after berry shatter would likely result in a reduced berry count per cluster. Gibberellic acid applications when performed in combination with either CT or CT plus cane girdling, significantly increased berry and cluster weight but had no significant effect on berry count per cluster,

total yield per vine, or fruit SSC (Table 2).

The narrow cane girdles (4 mm) used in the current studies typically allowed complete callus covering of the girdle in 3 to 4 weeks. About 75% of the girdles in these experiments became sufficiently healed to be retained at the time of dormant pruning. In practice, canes on renewal spurs basal to girdles as well as healed, girdled canes provided an abundance of quality fruiting canes over the duration of the experiments. The performance of fruiting canes originating apical or basal to well-healed cane girdles was similar.

The increased yields from girdling in the second experiment were associated with significant reductions in fruit SSC. The depressing influence of girdling on fruit soluble solids accumulation has been previously observed (Halbrooks and Mortensen, 1987; Harrell and Williams, 1987). A reduction in fruit soluble solids accumulation could be attributed to an inadequate leaf area : crop ratio (Kliwer and Weaver, 1971) and might be corrected by increasing that ratio and/or

by delaying the harvest date (Kingston and VanEppenhuisen, 1989).

Manipulations of 'Himrod' grapevines can produce desirable increases in berry weight, berries per cluster, cluster weight, and total yield. Cane girdling can have a desirable additive effect on these fruit characteristics when applied in several treatment combinations. Over the 3 years of this study, cane girdling produced no adverse effects on vine size and, therefore, this procedure may offer a new opportunity for sustainable commercial production of table grapes for a relatively cool growing season climate such as the Finger Lakes region of New York. However, because cane girdling in these studies did reduce fruit soluble solids accumulation, it will need to be practiced with a level of crop control and/or delay in harvest that will ensure acceptable levels of fruit SSC.

Literature Cited

- Halbrooks, M.C. and J.A. Mortensen. 1987. Influence of gibberellic acid and various management practices on berry, seed and cluster development in 'Orlando Seedless' grape. Proc. Fla. State Hort. Soc. 100:312-315.
- Harrell, D.C. and L.E. Williams. 1987. The influence of girdling and gibberellic acid application at fruit set on 'Ruby Seedless' and 'Thompson Seedless' grapes. Amer. J. Enol. Viticult. 38:83-88.
- Hofacker, W. 1978. Investigations on the photosynthesis of vines: Influence of defoliation, topping, girdling and removal of grapes. Vitis 17:10-22.
- Hussman, G. 1898. American grape growing and wine making. Orange Judd Co., New York, N.Y.
- Jacob, H.E. 1928. Some responses of the seedless *Vitis vinifera* to girdling. Proc. Amer. Soc. Hort. Sci. 25:223-229.
- Jacob, H.E. 1931. Girdling grapevines. Calif. Agr. Ext. Serv. Circ. 56:1-18.
- Jensen, F., D. Luvisi, F. Swanson, G. Leavitt, F.G. Mitchell, and G. Mayer. 1976. Effects of complete and incomplete girdles on 'Thompson Seedless' and 'Ribier' table grapes. Amer. J. Enol. Viticult. 27:65-67.
- Kingston, C.M. and C.W. VanEppenhuisen. 1989. Influence of leaf area on fruit development and quality of 'Italia' glasshouse table grapes. Amer. J. Enol. Viticult. 40:130-134.
- Kliwer, W.M. and R.J. Weaver. 1971. Effect of crop level and leaf area on growth, composition, and coloration of 'Tokay' grapes. Amer. J. Enol. Viticult. 22:172-177.
- Kriedemann, P.E. and F. Lenz. 1972. The response of vine leaf photosynthesis to shoot tip excision and stem cincturing. Vitis 11:193-197.
- Lider, L.A. and G.W. Sanderson. 1959. Effects of girdling and rootstock on crop production of the variety 'Chardonnay'. Proc. Amer. Soc. Hort. Sci. 74:383-387.
- New York Climate. 1991. Northeast Regional Climate Center, Cornell Univ., Ithaca, N.Y.
- Weaver, R.J. 1955. Relation of time of girdling to ripening of fruit of 'Red Malaga' and 'Ribier' grapes. Proc. Amer. Soc. Hort. Sci. 65:183-186.
- Winkler, A.J. 1953. Producing table grapes of better quality. Blue Anchor 30:28-31.
- Winkler, A.J. 1962. General viticulture. Univ. of Calif. Press, Berkeley.