Influence of Girdling and Gibberellic Acid on Yield Components, Fruit Composition, and Vestigial Seed Formation of 'Sovereign Coronation' Table Grapes

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Abstract. Vestigial seeds of 'Sovereign Coronation' table grapes frequently form partially developed seedless seeds that are perceptible on the surface of the berry. Prebloom gibberellic acid (GA3) sprays of 10 ppm GA3 at bloom; and 40 ppm GA3, 14 days later, GA3, 4 ppm GA3, 2 days later and 40 ppm GA3, 14 days later, were applied to stemmed 'Sovereign Coronation' vines to reduce seed trace formation. Prebloom GA3 treatments had no effect on yield or clusters per vine, but postbloom GA3 treatments decreased cluster and berry weights and reduced berries per cluster. Berry size was unaffected by girdling or GA3 treatments. Decreases in titratable acidity were associated with postbloom GA3 treatments. There was a trend for partial and complete seedless berries to be associated with GA3 treatments. Prebloom and postbloom GA3 treatments decreased the size and weight of vestigial seeds with GA3 applications reduced the number and weight of vestigial seeds with GA3. The phenomenon is caused by GA3-induced death of the ovule before bloom, after 14 days later; and 4 weeks later.

Materials and Methods

The trial was initiated in June 1998 as a 5-year-old block of 'Sovereign Coronation' vines grafted to SO4, spaced 1.5 m x 3.0 m for a partial vineyard row. Treatments were 1) control throughout the trial (Table 1). There were 15 treatments and each treatment was replicated three times. Each block comprised two vines per treatment replication (con). Fruit maturity was measured immediately after pruning. Results and Discussion

Since its release in 1977 (Denby, 1977), 'Sovereign Coronation' table grapes have become popular in many countries. There is an expanding market for 'Sovereign Coronation' table grapes. However, there are concerns that adverse environmental conditions may affect the yield of these grapes. In this experiment, we aimed to assess the efficacy of girdling and GA3 treatments on seed trace formation and berry size of 'Sovereign Coronation' table grapes. Since its release in 1977 (Denby, 1977), 'Sovereign Coronation' table grapes have become popular in many countries. However, adverse environmental conditions may affect the yield of these grapes. In this experiment, we aimed to assess the efficacy of girdling and GA3 treatments on seed trace formation and berry size of 'Sovereign Coronation' table grapes.
than that induced by later applications (Christodoulou et al., 1974). Moreover, single applications of GA3 at or around bloom have led to increased vine size in 1999 in vines treated with GA3 (Vielvoye, 1992). Girdling at bloom (GA1) for cluster number in 1998 and 1999, or for berry number and vine size in 1998 and 2000 (Table 1). Berry and cluster weight were the two yield components most affected by GA application and girdling. Berry weights were increased over the control by all treatments, but in particular by girdling and by either two or three GA applications (Table 1). A substantial increase in berry and cluster weight occurred in treatments GA2 and GA3 (two and three GA applications), as well as the cordon-girdled vines in 1999 (Table 1). There was also a slight decrease in berry number in GA-treated vines (treatments GA1 and GA3) in 1999 (Table 1).

The girdling and GA-induced increases in cluster and berry weights of seedless V. vinifera grapes are well documented (Weaver and McCune, 1959, 1961; Winkler et al., 1974). Moreover, single applications of GA, at or around bloom have led to increased berry and cluster weight as a result of berry thinning, but the berry weight increase is less than that induced by later applications (Christodoulou et al., 1968). Use of GA on seedless V. labruscana hybrids has also been proven to have similar effects (Shaulis, 1959). Vielvoye (1992) reported that girdling and one or two 40-ppm postbloom GA applications increased cluster and berry weights of ‘Sovereign Coronation’ in a similar experiment in British Columbia, but a single 1-ppm application at bloom had little impact.

The slight increase was also measured in vine size in 1999 in vines treated with GA, the previous season (Table 1). Vine size decreased from 1.03 kg/vine across all treatments in 1998 to 0.43 kg/vine in 2000, suggesting that the vines may have been overcropped in the final year of the trial. The reason for the reduction in vine size is not known; however, a 28% higher-than-average rainfall in 2000 (637 mm, compared to an average of 498 mm) (Ontario Grape Growers’ Marketing Board, 2001) with attendant soil waterlogging, may have been a contributing factor in limiting vegetative growth.

**Fruit composition.** Fruit composition data suggested that the GA treatments had either no effect or led to slight delays in fruit maturity in terms of soluble solids (‘Brix), with the exception of the GA1 and GA2 treatments in 1999 (Table 2). The single bloom GA application reduced ‘Brix in 1998, and had no effect on TA in 1998–2000 or on pH in 1998. However, at least one of the two postbloom GA treatments reduced TA and increased pH each season (Table 2). Girdling reduced ‘Brix in 2 of 3 seasons, decreased TA slightly in 1999, and increased pH in 1998 (Table 2).

Applications of GA, have been reported to advance fruit maturity (Christodoulou et al., 1968), delay maturity slightly (Christodoulou et al., 1968), or have had no effect (Weaver and McCune, 1961; Weaver et al., 1962), depending upon cultivar and season. Previous work with ‘Sovereign Coronation’ in BC using similar application timings suggested an enhancement in fruit maturity with both GA and girdling (Vielvoye, 1992).

**Vestigial seed formation.** As previous experience with stenospermocarpic varieties (Halbrooks and Greco, 1989; Halbrooks and Mortensen, 1987; 1988; Vielvoye, 1992), our data suggest that GA reduced vestigial seed formation (Fig. 1). Use of postbloom GA applications tended to reduce the number and weight of seeds with developed (brown, hard) seedcoats in 1998 (Fig. 1A). In 1999, the treatment involving three GA3 sprays also reduced the number and weight of green seeds (Fig. 1C and D). However, use of a third GA3 spray in 1999 did not effectively suppress formation of mature vestigial seeds when compared to a two-spray program (Fig. 1C and D).

In 2000, vestigial seed number and weight were substantially lower than the previous 2 years, and there were no differences relative to the control with respect to both brown and green seed number and weight (Fig. 1E and F). Girdling had no effect on vestigial seed formation throughout the trial (Fig. 1).

It is also noteworthy that vestigial seed number and weight varied considerably during the 3 years of the trial. In the dry 1998 and 1999 seasons, mean mature seed numbers in control treatments were 1.88 and 1.10, respectively, but only 0.12 in the much wetter 2000 season (Fig. 1A, C, and E). Moreover, mean weights of mature seeds in the control treatments were 24.4, 15.9, and 0.9 mg for 1998, 1999, and 2000, respectively, suggesting that environmental conditions, in this case lower than average rainfall (Ontario Grape Growers’ Marketing Board, 2001), might have played a part in their formation. It is also possible that the high crop loads (yield : vine size ratios) in 2000 (19.8) compared to those in 1998 and 1999 (7.6 and 9.1, respectively) may have reduced vestigial seed formation as well.

**Water relations.** Two of three sampling days produced no differences between untreated control and girdled vines with respect to leaf transpiration rates (Table 3). However, the third sampling date suggested a slightly higher transpiration rate in girdled vines. This is in contrast to prior work (Roper and
Williams, 1989) and others who have reported decreases in stomatal conductance (hence transpiration) of leaves on girdled vines. The reason for higher stomatal conductance in girdled ‘Sovereign Coronation’ in this study is unknown.

The results of this experiment suggest that one bloom spray plus two or three postbloom applications of GA₃ may be used to reduce the number and weight of vestigial seeds in ‘Sovereign Coronation’ table grapes. Moreover, use of postbloom GA₃ sprays will also increase the probability of higher berry weight and cluster weight than untreated vines. Girdling had no effect on vestigial seed formation in this trial, but it increased cluster weight and berry weight in all three seasons. These cultural practices should provide table grape growers in Canada and the northeast U.S., some competitive advantage in a market dominated by V. vinifera cultivars.

![Graph A](image1.png)

![Graph B](image2.png)

![Graph C](image3.png)

![Graph D](image4.png)

![Graph E](image5.png)

![Graph F](image6.png)

Fig. 1. Influence of girdling and gibberellic acid on vestigial seed formation in berries of ‘Sovereign Coronation’ table grapes, Queenston, Ont., 1998–2000.

Treatment legend: GA1 = 10 ppm GA₃ at bloom; GA2 = GA1 + 40 ppm GA₃, 14 d. postbloom; GA3 = GA2 + 40 ppm GA₃, 28 d postbloom. Means followed by different letters are significantly different at P ≤ 0.05, Duncan’s multiple range test. Significant P values for 1998–2000 were, respectively: 0.0001, 0.005, and 0.021 (green seed number); 0.0001, 0.026, and 0.050 (green seed weight); 0.0001, 0.050, and 0.700 (mature seed number); 0.0001, 0.050, and 0.636 (mature seed weight).
**GROWTH REGULATORS**

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