

Induction of Seedlessness in 'Triumph' Muscadine Grape (*Vitis rotundifolia* Michx.) by Applying Gibberellic Acid

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Abstract. Gibberellic acid (GA₃), a plant growth regulator used routinely in the production of seedless bunch grapes, was sprayed on the seeded muscadine grape cultivar Triumph. GA₃ at 100, 200, and 300 mg·L⁻¹ was sprayed on the leaves and fruit clusters at late bloom; a second spray followed 1 week later. The sprayed vines produced more than 20% seedless berries and the size of the berries with seeds increased significantly. GA₃ application in commercial muscadine grape production may have potential benefits.

Gibberellic acid has been routinely used for seedless bunch grape production (Ledbetter and Ramming, 1989). For example, it can be used to increase berry and bunch size (Butler and Rush, 1994; Harrell and Williams, 1987; Varma, 1991; Zabadal and Bordelon, 1993), and reduce the size of the seed trace (Halbrooks and Mortensen, 1988). Exogenous GA₃ has also been found to affect fruit and seed formation of seeded (i.e., with seeds) bunch grapes (*Euvitis* Planch.). For example, Pratt and Shaulis (1961) obtained a high percentage of seedless fruit from two normally seeded 'Fredonia' grapes by spraying gibberellic acid on the vines, particularly under conditions of inadequate or no pollination. Fellman et al. (1991) reported a high percentage of "seedless" berries from the seeded grape 'Swenson Red' when GA₃ was sprayed on the foliage before and after anthesis. Nearly 100% seedless fruit were obtained in 'Delaware' (*V. labrusca* L.) by dipping flower clusters in GA₃ at 100 mg·L⁻¹ ≈10 days before and again 10 days after anthesis (Clore, 1965; Ito et al., 1969). Fukunaga and Kurooka (1988) reported that seedless berry set was almost 100% when GA₃ at 200 mg·L⁻¹ was applied at anthesis of 'Kyoho' grapes. They also concluded that the later the application, the lower the percentage of seedlessness. GA₃ has been used to convert seeded cultivars into "seedless" ones by commercial Japanese growers (Kajiura, 1962; Sugiura and Akitsuga, 1966). Although various effects of GA₃ on seeded and seedless bunch grape cultivars have been well documented, we did not find any report of GA₃ application on muscadine grapes.

At least 50 muscadine grape cultivars have been released by public and private breeders in the southeastern United States. Among them,

the only seedless cultivar is 'Fry Seedless' (Ison, 1994). However, the low productivity and small berry size of 'Fry Seedless' limit its acceptance by growers. Lack of a good seedless cultivar has limited commercial production of muscadine grapes for table consumption. This study was designed to determine the usefulness of GA₃ application for induction of seedlessness and enhancement of berry size for muscadine grapes.

Materials and Methods

Five- to six-year-old vines of the muscadine cultivar 'Triumph' were used in this study. The plants were grown on a single wire trellis system with spur pruning in the experimental vineyard at Florida A&M Univ., Tallahassee. The source of the gibberellic acid was ProGibb 4% (Abbott Laboratories, North Chicago, Ill.). GA₃ at 100, 200, and 300 mg·L⁻¹ was sprayed on the leaves and flower/fruit clusters. The first spray was at late bloom with ≈70% of flowers opened (17 May 1994 and 18 May 1995), followed by a second spray a week later (berries were ≈4 mm in diameter at this stage).

Water was sprayed as a control. The experiment was first conducted in 1994, and the same vines received same treatment in 1995. Two vines were used for each treatment. After fruit were fully matured, 10 clusters were randomly harvested from each vine to determine the percentage of seedlessness, berry weight, number of seeds per berry, and seed weight.

The data were analyzed using the SAS (SAS Institute, Cary, N.C.) General Linear Models Procedure for linear contrast to compare differences between the control and treatment means, and between the treatment means.

Results and Discussion

A mixture of seeded and seedless berries were found in clusters of 'Triumph' after GA₃ treatments. The seedless berries were characterized by smaller size, with three to four aborted seeds, or seed traces. GA₃ significantly increased the number of seedless berries. Between ≈20% and 25% of berries were seedless following treatment with GA₃, compared with 4.0% for the control (Table 1). The percentage of seedlessness was similar for the various GA₃ treatments.

Seed weight in the "seedless" berries was similar to that in seedless stenosperry *V. vinifera* L. grapes (Ledbetter and Shonnard, 1991), with an average of 6.7 mg/seed, compared to 66.7 mg in the regular seeded berries. The average weight of seed traces was similar in the naturally occurring and in the GA₃-induced seedless berries. The number of seeds and seed traces found in seeded and seedless berries was similar (≈3.5/berry) in control and GA₃-treated vines.

Compared to the nontreated vines, seeded berries in GA₃-treated vines weighed significantly more (Table 2). Those treated with GA₃ at 200 and 300 mg·L⁻¹ weighed ≈20% more than berries of the control. GA₃ concentration had no significant effect on berry weight. The average weight of the seedless berries was similar, i.e., 4.6 to 5.0 g, regardless of GA₃ concentration.

Table 1. Percentage of seedless berries produced by 'Triumph' grape following GA₃ treatments and control.²

GA ₃ concn (mg·L ⁻¹)	Seedless berries (%)	F value of orthogonal contrast			
		GA ₃ concn (mg·L ⁻¹)			
		0	100	200	300
0	4.0 ± 0.7	0	0	37.78**	30.13**
100	18.9 ± 0.7		0	2.48 ^{ns}	0.84 ^{ns}
200	24.1 ± 4.7			0	0.43 ^{ns}
300	21.9 ± 4.4				0

²Means of 1994 and 1995.

^{ns}, *^{ns} Nonsignificant or significant (linear contrast analysis) at P ≤ 0.05 or 0.01, respectively.

Table 2. Effects of GA₃ treatment on berry weight (g/berry) of 'Triumph' grape.²

GA ₃ concn (mg·L ⁻¹)	g/berry	F value of orthogonal contrast			
		GA ₃ concentration (mg·L ⁻¹)			
		0	100	200	300
0	8.75 ± 0.83	0	4.81*	15.89**	15.94**
100	9.73 ± 0.13		0	3.22 ^{ns}	3.24 ^{ns}
200	10.52 ± 0.63			0	0.00 ^{ns}
300	10.52 ± 0.63				0

²Means of normal seeded berries.

^{ns}, *^{ns} Nonsignificant or significant (linear contrast analysis) at P ≤ 0.05 or 0.01, respectively.

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Results from this study indicate that GA₃ can induce 20% to 25% seedless berries in the seeded muscadine cultivar Triumph. Since no seedless muscadine cultivar is available for commercial production, application of GA₃ may have some potential usefulness for commercial production of seedless muscadine grapes. Although, as judged by weight, size of the seedless berries was reduced by about half, the loss might be compensated for by the significantly increased size of the seeded berries. Therefore, the cluster weight and the total yield might not be affected even with more than 20% smaller berries.

Berry size and seedlessness were not significantly increased when GA₃ concentration was increased above 100 mg·L⁻¹. Thus, lower concentrations may be useful, since GA₃ < 100 mg·L⁻¹ effectively induces seedless berries from seeded bunch grapes (Fukunaga and Kurooka, 1988). Further investigation to determine the effectiveness of various concentrations, application dates, and number of applications is necessary before a schedule with minimal chemical and labor cost and optimum effectiveness can be recommended.

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