HortScience 32(1):89–90. 1997.

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

Jiang Lu[1], Olusola Lamikanra[2], and Stephen Leong[3]
Center for Viticultural Sciences, Florida A&M University, Tallahassee, FL 32307

Additional index words. growth regulator, table grapes, berry size, stenospermy

***Abstract.* Gibberellic acid (GA_3), a plant growth regulator used routinely in the production of seedless bunch grapes, was sprayed on the seeded muscadine grape cultivar Triumph. GA_3 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. GA_3 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 GA_3 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 GA_3 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 GA_3 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 GA_3 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. GA_3 has been used to convert seeded cultivars into "seedless" ones by commercial Japanese growers (Kajiura, 1962; Sugiura and Akitsuga, 1966). Although various effects of GA_3 on seeded and seedless bunch grape cultivars have been well documented, we did not find any report of GA_3 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 GA_3 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.). GA_3 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 GA_3 treatments. The seedless berries were characterized by smaller size, with three to four aborted seeds, or seed traces. GA_3 significantly increased the number of seedless berries. Between ≈20% and 25% of berries were seedless following treatment with GA_3, compared with 4.0% for the control (Table 1). The percentage of seedlessness was similar for the various GA_3 treatments.

Seed weight in the "seedless" berries was similar to that in seedless stenospermic *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 GA_3-induced seedless berries. The number of seeds and seed traces found in seeded and seedless berries was similar (≈3.5/berry) in control and GA_3-treated vines.

Compared to the nontreated vines, seeded berries in GA_3-treated vines weighed significantly more (Table 2). Those treated with GA_3 at 200 and 300 mg·L^{-1} weighed ≈20% more than berries of the control. GA_3 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 GA_3 concentration.

Table 1. Percentage of seedless berries produced by 'Triumph' grape following GA_3 treatments and control.[z]

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

[z]Means of 1994 and 1995.
$^{NS, *, **}$Nonsignificant or significant (linear contrast analysis) at $P \leq 0.05$ or 0.01, respectively.

Table 2. Effects of GA_3 treatment on berry weight (g/berry) of 'Triumph' grape.[z]

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

[z]Means of normal seeded berries.
$^{NS, *, **}$Nonsignificant or significant (linear contrast analysis) at $P \leq 0.05$ or 0.01, respectively.

Received for publication 20 Dec. 1995. Accepted for publication 22 July 1996. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.
[1]Assistant Professor, Geneticist, and Breeder.
[2]Professor.
[3]Associate Professor.

Results from this study indicate that GA_3 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 GA_3 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 GA_3 concentration was increased above 100 $mg{\cdot}L^{-1}$. Thus, lower concentrations may be useful, since $GA_3 < 100$ $mg{\cdot}L^{-1}$ 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.

Literature Cited

Butler, M.D. and R.E. Rush. 1994. Influence of gibberellic acid on sizing of 'Thompson Seedless' grapes in southwest Arizona. HortScience 19:546. (Abstr.)

Clore, W.J. 1965. Responses of Delaware grapes to gibberellin. Proc. Amer. Soc. Hort. Sci. 87:259–263.

Fellman, C., E. Hoover, P.D. Ascher, and J. Luby. 1991. Gibberellic acid-induced seedlessness in field-grown vines of 'Swenson Red' grape. HortScience 26:873–875.

Fukunaga, S. and H. Kurooka. 1988. Studies on seedlessness of 'Kyoho' grapes induced by gibberellin in combination with streptomycin (in Japanese, with English summary). Bul. Univ. of Osaka. Ser. B: Agr. & Biol. 40:1–10 .

Halbrooks, M.C. and J.A. Mortensen. 1988. 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 fruitset on 'Ruby Seedless' and 'Thompson Seedless'. Amer. J. Enol. Viticult. 38:83–88.

Ison, B. 1994. Compendium and catalog for the grower of muscadine grapes and other fine fruits and berries. Ison's Nursery and Vineyards, Brooks, Ga.

Ito, H., Y. Motomura, Y. Konno, and T. Hatayama. 1969. Exogenous gibberellin application as responsible for the seedless berry development of grapes. I. Physiological studies on the development of seedless 'Delaware' grapes. Tohoku J. Agr. Res. 20:1–18.

Kajiura, M. 1962. Gibberellin application for seedless 'Delaware' grape production in commercial vineyard in Japan. 16th Proc. Intl. Hort. Congr. 3:496–500.

Ledbetter, C.A. and D.W. Ramming. 1989. Seedlessness in grapes. Hort. Rev. 11:159–184.

Ledbetter, C.A. and C.B. Shonnard. 1991. Berry and seed characteristics associated with stenospermy in *vinifera* grapes. J. Hort. Sci. 66:247–252.

Motomura, Y. and H. Ito. 1972. Exogenous gibberellin as responsible for the seedless berry development of grapes. II. Role and effects of the prebloom gibberellin application as concerned with flowering, seedlessness and seedless berry development of 'Delaware' and 'Campbell Early' grapes. Tohoku J. Agr. Res. 23:15–32.

Pratt, C. and N.J. Shaulis. 1961. Gibberellin-induced parthenocarpy on grapes. Proc. Amer. Soc. Hort. Sci. 77:322–330.

Sugiura, A. and I. Akitsuga. 1966. Studies on the mechanism of gibberellin-induced seedlessness of 'Delaware' grapes. I. The effect of pre-bloom gibberellin treatment on pollen germination. J. Jpn. Soc. Hort. Sci. 35:31–39.

Varma, S.K. 1991. Effect of dipping flower cluster in gibberellic acid on fruit set bunch and berry size yield and fruit quality in grapes (*Vitis vinifera* L.). Indian J. Agr. Res. 25:54–58.

Zabadal, T.J. and B.P Bordelon. 1993. Timing and concentration of gibberellic acid applications for berry thining and sizing of 'Vanessa Seedless' grapes. HortScience 28:210. (Abstr.)