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Influence of Application Time and Gibberillic Acid Concentration on 'Seyval Blanc' Grapes

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Abstract

Gibberellic acid (GA_3) applied at bloom was more effective than an application four weeks after bloom in reducing cluster weight and yield and increasing juice soluble solids. Cluster weight, good berries per cluster, and berries with rot were increased by hand-thinning at bloom. Cluster weights compared to unthinned vines were decreased linearly as GA_3 concentration increased. Berry weight increased and berries per cluster decreased linearly with increasing rates of GA_3. The effects of GA_3 on clusters per vine and juice titratable acidity were inconsistent over the three-year study. Juice soluble solids increased with increasing GA concentration with a similar effect on pH in two out of three years. Although an optimum concentration was not determined, GA_3 at approximately 60 ppm resulted in a response similar to hand-thinning in reducing yield and improving juice quality.

Introduction

The French-American hybrid grape cultivar 'Seyval blanc' is very hardy (1) with good wine quality under midwest conditions. However, it tends to overcrop because of production of fruitful shoots from noncount buds which can lead to decreased growth and lowered wine quality. It has large, compact clusters that are subject to bunch rot. Hand thinning to adjust the crop is time-consuming and costly and a means to thin chemically has been sought.

A recent study attempting to reduce grape cluster compactness and bunch rot found that GA_3 at 45 ppm caused thinning in one out of four years in 'Vignoles', a French hybrid, and one out of three years with 'Pinot Gris', a *vinifera* cultivar (3). *Vinifera* cultivars such as 'Thompson Seedless', 'Tinta Madeira' and 'Carignane' are thinned by low (2.5-5 ppm) concentrations of GA_3 (2,5), while 'Zinfandel', 'Tokay', and 'Semillon' require higher GA_3 concentrations (10-50 ppm) to thin fruit and thereby loosen clusters (4,6). Thinning by bloom sprays of GA_3 was reportedly due to the effect of GA_3 as a pollenicide (7). Applications of GA_3 to individual clusters at two locations in Ohio several weeks after bloom reduced cluster weight of 'Pinot Gris' (3). Based on these reports, studies were established to determine if applications of GA_3 at bloom or several weeks after bloom caused thinning of 'Seyval blanc' and what concentration gave the most consistent results.

Materials and Methods

In 1998 and 1999, mature own-rooted 'Seyval blanc' vines established in 1982 at a spacing of 1.25 m x 3.0 m and trained as single cordons leaving 20 buds on 5-bud canes were used to evaluate the potential of GA_3 as a chemical thinner. Spray applications were made either at bloom (60-80% open flower) or four weeks after bloom with a high pressure hand-gun to drip. Gibberellic acid (GA_3-ProGib, Abbott Labs) was applied at 30, 60, 90 or 120 ppm and compared to an unsprayed control. Treatments were arranged as a 2 x 5 factorial in a randomized complete block design with six single-vine replications.

From 2000 through 2002 vines in the vineyard described above, but spaced 1.8 m x 3 m and trained as a bilateral cordon leaving 30 buds on 5-bud canes were treated annually with the GA_3 concentrations described above applied at bloom (60-80%

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Table 1. Influence of time of application and various concentrations of gibberellic acid (GA_3) on yield and juice quality of 'Seyval blanc' grapes.

		1998						1998					
					Juice						Juice		
Treatment	ppm	Cluster number	Cluster wt. (g)	Yield (kg)	Soluble solids (%)	pH	TA[y] (gL^{-1})	Cluster number	Cluster wt. (g)	Yield (kg)	Soluble solids (%)	pH	TA[y] (gL^{-1})
Control	0	14.1	216	3.19	17.7c[z]	3.29	10.8a	29.3	302	3.95	21.9	3.28	7.06
GA_3	30	15.0	269	4.00	18.9bc	3.28	10.4bc	35.6	261	4.07	22.2	3.29	7.00
GA_3	60	14.2	243	3.40	19.2ab	3.29	10.0c	32.0	261	3.83	22.3	3.30	7.16
GA_3	90	16.0	252	4.06	18.0c	3.27	10.1c	35.2	270	4.15	21.8	3.25	7.07
GA_3	120	17.7	244	4.25	19.4a	3.30	10.5ab	43.9	225	4.16	21.8	3.24	7.26
Linear		NS	NS	NS	**	NS	*	*	NS	NS	NS	NS	NS
Quadratic		NS	NS	NS	NS	NS	**	NS	NS	NS	NS	NS	NS
Application Time													
Bloom		15.1	250	3.67	18.9	3.31a	9.9b	37.7	183b	2.96b	22.3a	3.28	7.27
Bloom + 4 weeks		16.1	253	4.12	18.6	3.27b	10.6a	354	328a	5.51a	21.8b	3.27	6.98
F Significance													
GA_3		NS	NS	NS	**	NS	**	NS	NS	NS	NS	NS	NS
App. time		NS	NS	NS	NS	**	**	NS	**	**	**	NS	NS
GA_3 x App. time		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z]Mean separation by Duncan's multiple range test $P \leq 0.05$.
[y]Titratable acidity

Table 2. Influence of various concentrations of gibberellic acid (GA_3) on yield, cluster composition and juice characteristics of 'Seyval blanc'.

		Cluster							Juice		
				Berry number/cluster							
Treatment	ppm	Weight (g)	Berry weight (g)	good	rot	shot	Cluster number per vine	Yield (kg/vine)	Sol. solids (%)	pH	Titratable acidity ($g*L^{-1}$)
						2000					
Control	-----	244b[z]	1.99c	127b	1.5b	21.3ab	125.5a	17.4a	16.1c	3.08c	9.39
Hand-thinned	-----	320a	1.93c	165a	4.0a	12.5b	42.3c	13.3ab	18.4b	3.15ab	8.93
GA_3	30	172c	2.08c	84c	0.8b	9.5b	109.0a	14.5ab	18.1b	3.12bc	9.20
GA_3	60	178bc	2.23ab	82c	2.6ab	25.8ab	72.5bc	9.9b	20.2a	3.17ab	8.88
GA_3	90	167c	2.36a	71c	1.9b	22.0ab	92.5ab	10.5b	20.7a	3.20a	8.47
GA_3	120	135c	2.42a	56c	1.8b	35.6a	101.5a	10.1b	19.7a	3.15ab	8.77
Linear[y]		**	**	**	NS	*	*	**	**	**	*
Quadratic		NS	NS	NS	NS	NS	**	NS	**	**	NS
						2001					
Control	-----	227b	1.65d	136a	1.0b	17.1	90ab	13.5a	17.4c	3.03b	8.02ab
Hand-thinned	-----	299a	1.92cd	156a	5.6a	13.5	47c	8.2c	19.2a	3.12a	7.43b
GA_3	30	171b	2.08bc	84b	1.0b	10.2	108a	12.0ab	18.6bc	3.08ab	7.88ab
GA_3	60	186b	2.28ab	84b	1.0b	16.1	104a	9.7bc	19.7ab	3.10a	8.03ab
GA_3	90	176b	2.36ab	75b	0.8b	9.6	98ab	8.9bc	19.6ab	3.12a	7.56b

Table 2 (cont.).

Treatment	ppm	Cluster							Juice		
		Weight (g)	Berry weight (g)	Berry number/cluster			Cluster number per vine	Yield (kg/vine)	Sol. solids (%)	pH	Titratable acidity ($g^{*}L^{-1}$)
				good	rot	shot					
GA_3	120	172b	2.45a	74b	1.1b	10.5	61c	6.7c	20.3a	3.12a	8.52a
Linear		**	**	*	NS	NS	**	**	**	*	NS
Quadratic		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
						2002					
Control	-----	201b	1.53c	127b	2.6b	13.1b	94.6a	14.7	19.4b	2.90b	7.88ab
Hand-thinned	-----	428a	1.67bc	255a	9.7a	24.5a	34.8b	13.2	20.7ab	3.24a	7.51b
GA_3	30	157b	1.56c	103bc	2.9b	4.2b	119.5a	14.6	19.3b	2.88b	8.37a
GA_3	60	150b	1.86ab	79c	3.5b	4.1b	113.8a	14.1	20.6ab	3.09ab	7.79ab
GA_3	90	168b	1.99a	82c	0.6b	2.7b	85.3a	11.5	20.9ab	2.94b	7.74ab
GA_3	120	159b	2.08a	83c	1.0b	5.3b	120.1a	14.1	21.2a	3.01ab	7.71ab
Linear		NS	**	**	NS	*	NS	NS	**	NS	NS
Quadratic		NS	NS	NS	NS	*	NS	NS	NS	NS	NS

[z]Mean separation within year by Duncan's multiple range test $P \leq 0.05$

[y]Linear and quadratic on rates of GA_3 NS, *, ** = nonsignificant or significant at $P \leq 0.05$ or 0.01, respectively.

flowers open). In addition to the unthinned treatment, a hand-thinned treatment was added by thinning each shoot to one (usually the basal) cluster just prior to bloom. Treatments were arranged as a randomized complete block with six single-vine replications.

At harvest, clusters per vine were counted and total weight recorded. A 100-berry sample was taken at random to determine mean berry weight and juice was extracted to determine pH, titratable acidity (TA) and soluble solids concentration (SSC). Beginning in 2000, five clusters at random were taken from each vine just prior to harvest, and weighed. Berries were removed, divided into good berries, berries with rot, and shot berries and counted.

Results

In 1998 cluster number, weight or yield were not affected by GA_3 concentration or time of application (Table 1). Juice SSC increased linearly as GA_3 concentration increased. Juice TA decreased as GA_3 concentration increased until 90 ppm with an increase occurring on vines treated with 120 ppm. In 1999, cluster number appeared to increase as GA_3 concentration increased whereas cluster weight, yield and juice parameters were not affected by GA_3 concentration. Delaying GA_3 application until 4 weeks after bloom decreased juice pH and increased TA in 1998. In 1999, cluster weight and yield were deceased with a corresponding increase in juice SSC from fruit treated at bloom compared to the later treatment.

These results were followed the next three years with the various GA_3 concentrations applied annually to the same vines at bloom to see if a consistent thinning response could be achieved equivalent to hand-thinning. Cluster weight, good berries, and berries with rot were consistently increased by hand-thinning (Table 2). Cluster weight was decreased by GA_3 with a linear effect of concentration in two out of three years. Berry weight increased and good berries/cluster decreased linearly with increasing rates of GA_3. The effect of GA_3 on clusters per vine and TA were inconsistent over years. Juice SSC tended to increase with increasing GA_3 concentration with a similar effect on pH in two out of three years.

Discussion

Bloom application of GA_3 in 1999 caused thinning of 'Seyval blanc' as shown by reductions in cluster weight and, although not significant, a similar trend was observed in 1998. Although other application times have been investigated, quite a number of studies have reported success in thinning a wide range of *vinifera* cultivars at bloom (2,4,5,6,7). In three subsequent years, cluster weight and good berry number per cluster were consistently, linearly reduced by bloom applications of GA_3. It was not clear from these results what the optimum concentration of GA_3 may be to match the effects of hand thinning, since possible over-thinning occurred in only one year at the highest (120 ppm) concentration. Generally, 60 ppm GA_3 resulted in similar effects to hand-thinning in yield and juice quality responses.

In addition to increasing cluster size, hand-thinning also increased cluster compactness as evidenced by the increase of berries with rot. The GA_3 treated clusters had fewer berries with rot and were similar to the untreated control. The number of shot berries tended to be increased by GA_3; this response was also reported by Weaver et al. (5).

Vines of 'Seyval blanc' have remarkable ability to compensate for the reduction in berry number per cluster caused by GA_3 or the increase in cluster weight caused by hand-thinning at bloom. Averaged over three-years, hand-thinning reduced cluster number by 60%, increased cluster weight increased 34%; therefore, yield was reduced by only 25%. Reduction in yield was significant in one year out of three compared to unthinned vines. However, juice SSC and pH were consistently increased by hand-thinning. Generally, GA_3 treatments thinned by reducing berries per cluster with vines compensating by increasing berry size. For example, the 60 ppm treatment reduced berries per cluster 37%, but berry size was increased 19% resulting in a 25% average reduction in yield over three years. The

increase in juice quality achieved by hand-thinning or the 60 ppm GA_3 treatment did not lower yields to unacceptable levels of production. Averaged over these years, the unthinned control produced 12.1 tons/acre, while the hand-thinned and 60 ppm GA_3 treatments produced 9.2 and 8.9 tons/acre, respectively.

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