85, 2500 ppm. Three hundred fruits were used for each treatment. After dipping for 5 minutes, the fruits were air-dried and stored, along with controls, in ventilated wooden crates at ambient storage (26 ± 2C; 45-65% relative humidity). The fruits were taken out of the crates after 15 days, and flesh homogenates of 10 fruits were used for analysis. Total carotenoid pigments were extracted with acetone and taken up with petroleum ether (bp 60-80C); β-carotene was separated on a magnesia supercell (1:3) column (6) and estimated colorimetrically, using a Spectronic-20 colorimeter, according to the method of Zechmeister and Polgar (7). All estimations were carried out on triplicate homogenate samples. The results are presented in Table 1.

Table 1. Total carotenoids and β-carotene in dip-treated mangoes after 15 days storage.

Treatment	Carotenoids[a] (μg/100 g)	
	Total	β-carotene
Control	10,885	5,088
a) Cold water; 25C for 5 min	10,648	4,627
b) Hot water; 53 ± 1C for 5 min	11,383	5,232
c) Cold water; 25C + Alar-85 (2500 ppm)	10,419	5,075
d) Hot water; 53 ± 1C + Alar-85 (2500 ppm)	13,310	7,219

[a]Average of 3 replicates.

Fruits dipped in hot aqueous solutions of Alar recorded maximum total carotenoids (1,3310 μg/100 g) and β-carotene (7219 μg/100 g), compared to the control or other treatments. A hot water dip alone (without Alar treatment) increased the total as well as β-carotene in fruits compared to a cold water dip or the control group. Fruits dipped in a cold aqueous solution of Alar recorded total and β-carotene values similar to untreated fruits, although Alar stimulated β-carotene development compared to cold water dip treatment. The results clearly indicate that Alar-85 at 2500 ppm in hot water, stimulated carotenoid, particularly β-carotene development in the mango fruit.

The manner in which dip treatment in hot water containing Alar hastens ripening and stimulates color development is not clearly known. Studies conducted in our laboratory indicated increased respiration rate and advanced respiratory climacteric maximum. It is, therefore, likely that the treatment increases the permeability of the external tissue and activates the enzymes responsible for carotene synthesis.

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Post-Year Effects of N-Dimethylaminosuccinamic Acid on 'Concord' Grapes, *Vitis labrusca* L.[1,2]

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Abstract. **The effects from the foliar aqueous sprays of DMAS applied between pre- and full-bloom to mature 'Concord' grape vines did not appear to be transmitted to the post-treatment year. The number of clusters per vine in the post-treatment year was not influenced either by the concentration or the time of application of DMAS. Yield of DMAS treated vines in the post-treatment year was highly correlated with the number of clusters per vine that year.**

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In a previous paper, the immediate effects of various singular foliar aqueous sprays of N-dimethylaminosuccinamic acid (DMAS) on 'Concord' grapes were reported (1). Treatments of DMAS were found, both in 1965 and 1966, to influence berry set, size of berries, cluster weight, vine yield, and cane development. It is the purpose of this report to indicate the performance of these same 'Concord' grape vines during the year after treatment, 1966 and 1967 respectively.

Treatments in 1965. Vines had been divided into 4 replications of similar pruning weights (1). Applications had been timed at pre-bloom on June 11, full-bloom on June 21, and post-bloom on June 30, 1965. DMAS, code B-995, was applied at concentrations of active material of 0, 750, 1250, 1750, or 2250 ppm. Vines were balanced pruned both in the pre-treatment and treatment years following the 30 + 10 procedure for leaving buds per vine (1).

In the year after treatment (1966), the effects of DMAS on cluster development were determined by obtaining from each plot vine the total weight of grapes, total number of clusters, and vine cluster weight; and from a 4-cluster sample on each plot vine the number of berries per cluster, cluster weight, weight per berry, % total soluble solids of the berry juice, and length of the cluster rachis. The sample clusters for each plot vine consisted of the basal cluster on each of 4 shoots

selected at random, which arose between the first and second wires on the trellis. However, sample clusters were taken only from the treatments made at pre-bloom and full-bloom at 0, 750, and 2250 ppm of DMAS.

During the dormant period, only pruning weight measurements were taken to determine the effect of treatments on vegetative development during the post-treatment year.

Treatments in 1966. The design of the experiment was the same as that used in 1965, and applications were made in the same manner (1). DMAS, 85% wettable powder formulation, had been applied at pre-bloom on June 20, and at first-bloom on June 22. Full-bloom in 1966 was on June 24, or when 50% of the flower caps had fallen off. Concentrations used were 0, 500, 750, or 1000 ppm of active material. Tween-20 was used at the rate of 2 ml per gal. Vines were balanced pruned both in the pre-treatment and treatment years following the 30 + 10 procedure for leaving buds per vine. However, pre-treatment pruning weights were used for establishing bud numbers at the end of the treatment year rather than the actual weights as used in the 1965 experiment. This was done because it was felt that DMAS treated vines were more vigorous, and thus could support a larger number of buds per vine, than treatment year pruning weights suggested.

In the year after treatment (1967), the effects of DMAS on cluster development were determined in the same manner as in the 1965 experiment, except that sample clusters were not taken. Pruning weight measurements were obtained during the dormant period to determine the effect of treatments on vegetative development.

Statistical analysis. Covariance analysis was used to remove variation among plots due to vine vigor which was characteristic of the plants before treatments began (1). The independent variable was the pre-treatment year pruning weight. However, in analyzing the data for sample basal clusters in the post-treatment year in the 1965 experiment, treatment pruning weight and post-treatment year number of clusters were used as the independent variables. Correlation coefficients were calculated to determine the degree of association of vine yield and number of clusters per vine in the post-treatment year with other variables that same year and in the previous year when DMAS was applied.

Tabular data are presented as adjusted means for concentrations and for periods of application. In the 1965 experiment, results were summarized for the combined pre-bloom and full-bloom application periods. In the 1966 experiment, the pre-bloom and first-bloom application periods were grouped together. Only data for DMAS-treated vines were included in the determination of differences between the periods of application.

Vine Performance. In both experiments for the post-treatment year, adjusted means were non-significantly different for number of clusters per vine, yield per vine, vine cluster weight, and pounds of 1-year prunings as influenced by either DMAS or time of application (Tables 1 and 2). However at 2250 ppm, there was a tendency for average cluster weight and yield per vine to be lower than for vines at the other concentrations of DMAS (Table 1).

Total yield of 'Concord' grape vines is based on the number of clusters and their average weight (1). On DMAS treated vines, yield in the treatment year was primarily a function of the number of clusters per vine (2). Further, a much higher degree of association was found between yield and number of clusters than between yield and average cluster weight (2, and unpublished data). In the post-treatment year, yield from DMAS vines was again highly correlated consistently with the number of clusters that year (Table 3). The significant correlation between the number of clusters in the post-treatment year and pre-treatment year pruning weight for the 750 ppm application of DMAS both in 1965 and 1966, is unexplainable. Average number of clusters per vine among treatment plots in 1966 and 1967 was non-significantly different (Tables 1 and 2). In general, however, the association between yield and number of clusters per vine appeared to be valid also for 'Concord'

Table 1. Post-year effects in 1966 from treatments applied in 1965 on mature 'Concord' grape vines with foliar sprays of N-dimethylaminosuccinamic acid (DMAS) at various concentrations and timings at pre-bloom and full-bloom.

	Adjusted means[x]					Adjusted means[x]	
	Concentrations over combined timings of pre- and full-bloom[y]					Timing over DMAS Treated only	
	2250 ppm	1750 ppm	1250 ppm	750 ppm	0 ppm	pre-bloom	full-bloom
Avg no. of clusters	84.3a[z]	91.8a	84.9a	82.7a	102.6a	82.9a	88.6a
Avg vine yield (lb.)	14.0a	16.1a	15.7a	15.2a	17.9a	15.0a	15.5a
Avg vine cluster wt (lb.)	0.16a	0.18a	0.18a	0.18a	0.18a	0.18a	0.18a
Avg vine 1-year prunings (lb.)	2.29a	2.68a	2.33a	2.27a	2.88a	2.36a	2.40a

[x]Covariance independent variable: Pre-treatment pruning weight, 1964-1965.

[y]Treatment timings: Pre-bloom, June 11; Full-bloom, June 21, 1965.

[z]Adjusted means in rows followed by the same letter are not significantly different from each other at the 5% level.

Table 2. Post-year effects in 1967 from treatments applied in 1966 on mature 'Concord' grape vines with foliar sprays of N-dimethylaminosuccinamic acid (DMAS) at various concentrations and timings at pre-bloom and first-bloom.

	Adjusted means[x]				Adjusted means[x]	
	Concentrations over combined timings of pre- and full bloom				Timing over DMAS Treated only	
Variables	2250 ppm	750 ppm	500 ppm	0 ppm	pre-bloom	full-bloom
Avg no. of clusters	88.2a	98.9a	93.4a	91.3a	94.5a	90.8a
Avg vine yield (lb.)	22.2a	25.4a	24.8a	24.7a	24.3a	23.2a
Avg vine cluster wt (lb.)	0.26a	0.26a	0.27a	0.27a	0.26a	0.26a
Avg vine 1-year prunings (lb.)	3.0a	2.4a	2.3a	2.8a	2.6a	2.4a

[x]Covariance independent variable: Pre-treatment pruning weight, 1964-1965.

[y]Treatment timings: Pre-bloom, June 11; Full-bloom, June 21, 1965.

[z]Adjusted means in rows followed by the same letter are not significantly different from each other at the 5% level.

grape vines treated with DMAS.

Sample basal clusters. For the post-treatment year, basal clusters were sampled only in the 1965 experiment and then only from the 0, 750, and 2250 ppm treatments, or the extremes in DMAS concentrations (Table 4). For the combined pre- and full-bloom applications, the average number of berries on sample clusters was significantly lower at 2250 ppm than at 750 and 0 ppm. However, average weight per berry was significantly less at 0 ppm; 2250 and 750 ppm were non-significantly different. The cumulative effect of the number of berries and berry weight, expressed as average cluster weight, was highly significantly greater at 750 ppm. Differences in % total soluble solids of the berries and the length of the rachis were non-significant. Consequently, in the post-treatment year, basal cluster development on vines sprayed the previous year with 750 ppm of DMAS was stimulated when compared to that on non-treated vines. Apparently this effect was due largely to increased berry size as expressed on a weight basis.

The post-treatment effect of DMAS at 750 ppm appeared to be limited to basal clusters only. No statistical difference in cluster weight was found among the treatments when the entire vine was considered (Table 4 *vs* Tables 1 and 2).

In conclusion, the effect of a foliar spray of DMAS applied to increase berry set and yield on 'Concord' grape vines was not transferred into the following year. The only exceptions in the post-treatment year were in the 1965 experiment where basal clusters were heavier in weight at 750 ppm of DMAS, and vine yield tended to be lower at 2250 ppm than for the other treatments.

In the post-treatment year, vines receiving DMAS between 750 and 1250 ppm the previous year, yield was found to be highly correlated with the number of clusters per vine. However, the number of clusters on the vines in the post-treatment year was not found to be associated in general with treatment the previous year, excepting at 750 where an association existed with pre-treatment pruning weight.

Table 3. Simple correlations between 'Concord' grape vine yield and number of clusters in the post-treatment year with various variables in the pre-treatment, treatment and post-treatment years, which received an aqueous foliar spray of N-dimethylaminosuccinamic acid (DMAS).

Variables correlated	Selected DMAS treatments treated 1965[y] (1966[z]) 1250 (1000) ppm	750 (750) ppm	0 (0) ppm
	Correlation coefficients		
Post-treatment year vine yield with:			
Pre-treatment year pruning wt	.683 (.497)	.648 (.783*)	.718* (.572)
Treatment year – –			
no. of clusters	.721* (.612)	–.133 (.532)	.209 (.820)
vine yield	.430 (.740*)	.039 (.409)	–.115 (.778*)
pruning wt	.530 (.307)	.660 (.889**)	.752* (.590)
Post-treatment year no. of clusters	.937**(.843**)	.955**(.933**)	.881**(.704)
Post-treatment year no. of clusters with:			
Pre-treatment year pruning wt	.596 (.638)	.734* (.744*)	.508 (.072)
Treatment year ––			
no. of clusters	.708* (.639)	– .054 (.575)	.308 (.333)
vine yield	.452 (.601)	.076 (.420)	.089 (.298)
pruning wt	.591 (.413)	.552 (.716*)	.736* (.147)

[y] Bud number for the post-treatment year was based on pruning weights for the treatment year.

[z] Bud number for the post-treatment year was based on pruning weights for the pre-treatment year.

*Significant at the 5% level.

**Significant at the 1% level.

Table 4. Post-year effects on sample basal clusters in 1966 from treatments applied in 1965 on mature 'Concord' grape vines with foliar sprays of N-dimethylamino-succinamic acid (DMAS) at various concentrations and timings at pre-bloom and full-bloom.

Variables	Adjusted means[x] Concentrations over combined timings of pre- bloom and full-bloom[y] 2250 ppm	750 ppm	0 ppm
Avg no. of berries	37.0a[z]	44.4b	43.1b
Avg wt per berry (g)	2.82b	2.89b	2.51a
Avg cluster wt (g)	107.0a	130.8b	110.0a
Total soluble solids of berries (%)	17.9a	18.1a	18.4a
Avg rachis length (mm)	103.9a	111.4a	117.1a

[x] Covariance independent variables: Treatment pruning weight (1965-1966) and post-treatment number of clusters (1966).

[y] Treatment timings: pre-bloom, June 11; full-bloom, June 21, 1965.

[z] Adjusted means in rows followed by the same letter are not significantly different from each other at the 5% level.

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