The high proportion of seedless fruits reflects the limited amount of cross-pollination occurring, yet preventing insect pollination greatly reduced set. This indicates that a limited amount of pollen of other varieties was available for cross-pollination by bees. The effects of GA_3 on blossoms which were bagged or whose styles were cut confirm the responses obtained by previous workers. However, GA appears to have limited use in commercial pear growing under New York conditions, even in the absence of adequate cross-pollination. An increase in yield was observed only when the controls set very few fruits (Orchard A, 1968), while a reduction in yield occurred when fruit set was heavy (Orchard B, 1965). In areas where spring frosts are a hazard, its use might be beneficial, especially if inhibition of flowering can be limited by petal fall application of Alar as suggested by the data in Table 3.

Table 3. Effects of potassium gibberellate (KGA_3) and Alar upon fruit set and flower bud formation, 1965-66.

Treatment 1965[x]	Fruits/100 flower clusters[y] 1965	% Spurs flowering[y] 1966
Orchard A		
Tween 20 only	–	50[b]
KGA_3, 100 ppm	–	5[a]
KGA_3, 100 ppm plus Alar, 1000 ppm	–	26[b]
Orchard B		
Tween 20 only	78[b]	16[b]
KGA_3, 25 ppm	19[a]	8[ab]
KGA_3, 50 ppm	52[ab]	3[a]
KGA_3, 50 ppm plus Alar, 500 ppm	35[a]	13[b]

[x]KGA_3 applied at petal fall (Orchard B) or at full bloom or petal fall (Orchard A); Alar applied at petal fall.

[y]Within sets, means not followed by the same letter are significantly different from one another at the 5% level.

Table 4. Effects of gibberellic acid (GA_3) and Alar upon fruit set, seed development, and flowering. Orchard A, 1968-69.

	GA_3 (ppm)			Alar (ppm)		
	0	20	40	0	500	1000
Fruits/100 flower clusters	1.1	9.6**	7.8**	4.2	7.6	6.2
% Seedless fruits	25	76**	82**	57	58	68
% Spurs flowering	86	76	74	77	73	87

**Significantly different from no GA_3 at the 1% level.

Literature Cited

1. Batjer, L. P., M. W. Williams, and G. C. Martin. 1964. Effects of N-dimethyl amino succinamic acid (B-Nine) on vegetative and fruit characteristics of apples, pears, and sweet cherries. *Proc. Amer. Soc. Hort. Sci.* 85:11-16.
2. Duncan, D. B. 1955. Multiple range and multiple-F tests. *Biometrics* 11:1-42.
3. Griggs, W. H., and B. T. Iwakiri. 1954. Pollination and parthenocarpy in the production of Bartlett pears in California. *Hilgardia* 22:643-678.
4. Griggs, W. H., and B. T. Iwakiri. 1961. Effects of gibberellin and 2,4-5-trichlorophenoxypropionic acid sprays on Bartlett pear trees. *Proc. Amer. Soc. Hort. Sci.* 77:73-89.
5. Griggs, W. H., and B. T. Iwakiri. 1968. Effects of succinic acid 2,2-dimethylhydrazide (Alar) sprays used to control growth in Bartlett pear trees planted in hedgerows. *Proc. Amer. Soc. Hort. Sci.* 92:155-166.
6. Luckwill, L. C. 1962. The effect of gibberellic acid on the cropping of pears following frost damage. *Ann. Rep. Long Ashton Agr. and Hort. Res. Sta.* 1961:61-66.
7. May, Joyce M. 1952. Extended and corrected tables of the upper percentage points of the "studentized" range. *Biometrika* 39:192-193.
8. Modlibowska, Irena. 1961. Stimulation of fruit development in frost damaged pears. *Ann. Rep. East Malling Res. Sta.* 1960:46-48.
9. Modlibowska, Irena. 1963. Effect of gibberellic acid on fruit development of frost damaged Conference pears. *Ann. Rep. East Malling Res. Sta.* 1962:64-67.
10. Snedecor, G. W. 1956. Statistical methods. Iowa State College Press, Ames.
11. Varga, A. 1963. Tuinbouwkundige toepassingen van gibberellazuur. Publ. 241 Laboratorium voor Tuinbouwplantenteelt der Landbouwhogeschool, Wageningen. 84 p.
12. Varga, A. 1964. Toepassingen van gibberellinen (GA) in de fruitteelt. *Meded. Dir. Tuin.* 27:332-337.
13. Varga, A. 1966. Preventieve of curatieve bestrijding van nachtvorstschade. *De Fruitteelt* 56:350-351.

Effect of Succinic Acid 2, 2-Dimethyl Hydrazide on Carotene Development in 'Alphonso' Mango[1]

H. Subramanyam and K. Sebastian[2]

Central Food Technological Research Institute, Mysore-2A, India

Abstract. **Five minute dips in aqueous solutions of 2,500 ppm Alar at 25C had no consistent effect on carotene content of the flesh of 'Alphonso' mangoes. A similar dip at 53C caused an increase in both total carotenoids and in β-carotene. This was associated with increased respiratory rate and advance of the respiratory climacteric.**

[1]Received February 9, 1970.

[2]The authors thank Dr. H. A. B. Parpia, Director, for his encouragement and Naugatuck Chemical Division, United States Rubber Company, for the gift sample of Alar-85.

Succinic acid 2,2-dimethyl hydrazide (Alar) has been extensively used in recent years by horticulturists for the stimulation of external fruit color (1, 2). Many other chemicals and auxins are also used as pre- or post-harvest treatments to enhance color and improve the market quality of fresh produce (3, 4).

Earlier investigations in this laboratory indicated accelerated ripening and advanced respiratory climacteric maximum when mango fruit was treated with Alar as a post-harvest, momentary dip (5). It was thought desirable to examine the effect of this treatment on the development of carotenoids in the mango fruit.

Mature 'Alphonso' mangoes harvested from a nearby orchard were used in this investigation. The fruits were dip-treated within 24 hours after harvest as follows: 1) cold water at 25C; b) hot water at 53 ± 1C; c) cold water at 25C containing Alar 85, 2500 ppm; and d) hot water at 53 ± 1C containing Alar

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.

Literature Cited

1. Edgerton, L. J., and M. B. Hoffman, 1966. Inhibition of fruit drop and color stimulation with N-dimethyl amino succinamic acid. *Nature*. 209(5020):314-315.
2. Tehrani, Ghassem, and Fuleki Tibor. 1969. The effect of succinic 2,2-dimethyl hydrazide (Alar) on color development of Montmorency tart cherry (Abstract). *HortScience*. (Section two) 4(2):151.
3. Blanpied, G. D. 1966. Towards better size and color in Irish apples. *Fm. Res. News*. 7:40-41.
4. Smock, R. M. 1969. Laboratory studies on the effect of chemicals on the coloration of apples. *J. Amer. Soc. Hort. Sci.* 94:49-51.
5. Annual Report 1968. Cent. Food Tech. Res. Insti. (CSIR), India.
6. Assoc. of Vitamin Chemists. Methods of vitamin assay 1951. 2nd Ed. Int. Sci. Pub. Inc. New York.
7. Zechmeister, L. and A. Polgar, 1943. Cis-trans isomerization and spectral characteristics of carotenoids and some related compounds. *J. Am. Chem. Soc.* 65:1522-1528.

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

Loren D. Tukey and Harold K. Fleming
The Pennsylvania State University, University Park

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.**

[1]Received for publication February 12, 1970.
[2]Paper No. 3647 in the Journal Series of the Pennsylvania Agricultural Experiment Station, University Park, 16802. Appreciation is expressed to Dr. Richard Craig, Department of Horticulture, for help with the computer programs and statistical analysis. This research has been supported in part by funds received from the UniRoyal Chemical Division of UniRoyal, Inc., Bethany, Conn.

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