

Effect of Daminozide on Nutrient Accumulation in 'McIntosh' Apple Fruits¹

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Abstract. Succinic acid-2,2-dimethyl hydrozide (daminozide) treatment reduced both N concentration (dry wt basis) and content (mg/fruit) of 'McIntosh' apple (*Malus domestica* Borkh.) early in the growing season. Ca concentration was higher in treated fruits at the beginning and end of the growing season but, due to fruit wt reduction by daminozide, Ca content per fruit was not significantly different. Daminozide did not influence either concentration or content of P, K, Mg, Fe, Mn, or Zn. Concentrations of all elements examined decreased during the growing season while total content per fruit increased.

Daminozide is a growth retardant widely used in regulating vegetative growth and fruit quality in commercial apple production. It has been shown to influence the nutritional condition of apple trees as determined by foliar analysis (1, 3, 5, 10), but less attention has been given to the nutritional status of the fruit. In this paper we report some nutritional changes in 'McIntosh' apple fruit during one growing season as influenced by 6 consecutive years of daminozide treatment.

Four rows of 17-yr-old 'McIntosh' apple trees on Malling 7 rootstocks were selected, 2 rows of which had been sprayed with 2000 ppm daminozide in mid-June for 6 consecutive years (1969 - 1974). Six trees were randomly selected in each row and a sample of 10 fruits per tree were collected at a height of 1.5 m on 9 dates throughout the 1974 growing season from 28, to 140 days after full bloom.

Fruits were weighed, washed several times in distilled water, frozen, and were later thawed, quartered and the core tissue removed. Quartered sections of peel and pulp tissue were dried at 80°C and ground in a Wiley mill to pass a 40 mesh screen. Analyses of K, Ca, Mg, Fe, Mn, and Zn were performed on a Perkin-Elmer 403 Atomic Absorption Spectrophotometer following the procedure of Jones and Issac (4). N was determined by the standard Kjeldahl method. P was determined colorimetrically by the ammonium

molybdate method. Data were analyzed for statistical significance by the t-test.

Fruit concn of N, P, K, Ca, Mg, Fe, Mn and Zn decreased during the growing season, while the total content of each element increased in the fruit throughout the season. Only Ca and N levels differed in response to daminozide treatment.

Ca concn was found to be significantly increased ($P < 5\%$) in daminozide-treated fruit for the first 3 and last 3 sample dates (Fig. 2). The concn of N was significantly lower in daminozide-treated fruit for the first 5 sample dates, but later showed no statistical difference between treatments. The total N content was lower in daminozide-treated fruit for the first 4 sample dates (Fig. 1).

The reduction in N concn in daminozide-treated fruit agrees with the findings of Ashby and Looney (1) for N concn in the pulp and peel of 'Spartan' apples, along with reduced foliar N levels. We previously reported a significant decrease in foliar N concn in the same treatment blocks in response to daminozide (3). Martin et al. (5) also found daminozide treatments reduced soluble N content of the fruit. Singh noted a reduction in leaf N in 1-year-old trees in sand culture (9).

Increased fruit Ca concn in response to daminozide also concur with the results of Ashby and Looney (1). Martin et al. (5) also reported increased Ca concn in 'Cleopatra' and 'Jonathan' fruit as a result of daminozide treatment. Experiments by Naumann (6) on 'Cox's Orange Pippin' showed daminozide significantly increased fruit Ca concn and reduced the development of bitter pit. He noted a significant reduction in leaf Ca concn which accompanied increased fruit Ca concn. This suggests a simple redistribution of Ca between potential metabolic sinks, which could be accounted for by his observed 16% reduction in shoot

growth. However, our earlier results show leaf Ca levels in this block to be increased by daminozide (3).

It is of particular importance that fruit Ca levels increased because of the extensive list of physiological disorders associated with a localized inadequacy of Ca (8). The lower Ca concn in untreated fruit might be a dilution effect due to larger fruit size, since there is no significant content difference between treatments at the end of the season. However, the 9% increase in Ca and the 13% decrease in N content strongly indicate a real influence of daminozide upon nutrient accumulation.

N nutrition may have an important influence on the Ca nutrition of the tree, particularly on the fruit Ca status. N uptake during early fruit development may reduce fruit Ca concn by providing a preferential metabolic sink via the stimulation of shoot growth (8). The effect of daminozide in reducing both foliar N concn and shoot growth (3) may be beneficial in avoiding this antagonism. Furthermore, reduced foliar N levels should also reduce fruit size, and fruit size has been negatively correlated with Ca concn (2). Shear (9) reported a high positive correlation between the incidence of both bitter pit and cork spot, and the N/Ca ratio in both leaves and fruit. The present results are encouraging in that N was reduced and Ca was increased concurrently. The use of daminozide may be an important orchard management factor in the prevention of certain metabolic disorders associated with low Ca concn, while helping to maintain fruit quality and storage life. However, such benefits have rarely been reported and negative effects may even occur (7). Daminozide may also be of value in regulating fruit N, which may aid in reducing delayed maturity and storage problems associated with high N levels.

The daminozide-treated apples were significantly lower in fresh wt ($P < 1\%$) at all sample dates. Daminozide-treated fruit weighed an average of 12 g less than control fruit on the final sample date. This represented a reduction of 11% compared to controls.

Significant fruit weight differences during the sampling period along with significant Ca and N concn differences between treatments at the beginning of the growing season, suggest a carry-over effect from previous applications. These results support the contention that long term use of daminozide has a small but significant effect on yield and nutritional status of 'McIntosh' apples which may beneficially affect storage quality as it relates to physiological disorders associated with localized inadequate Ca concn.

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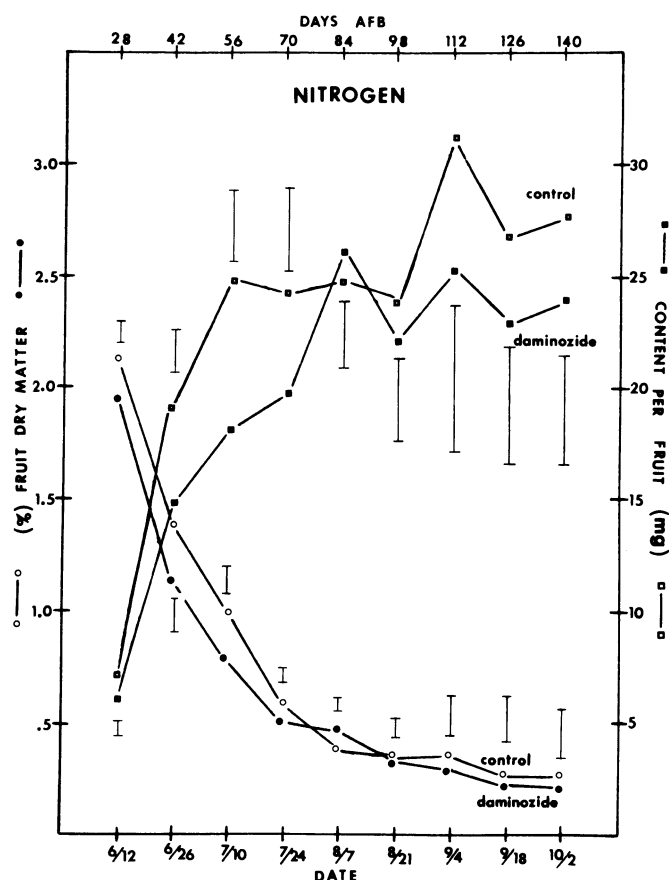


Fig. 1. Conc'n and total content of N in control and daminozide-treated fruit during the growing season. Vertical bar is LSD 5% level among treatments.

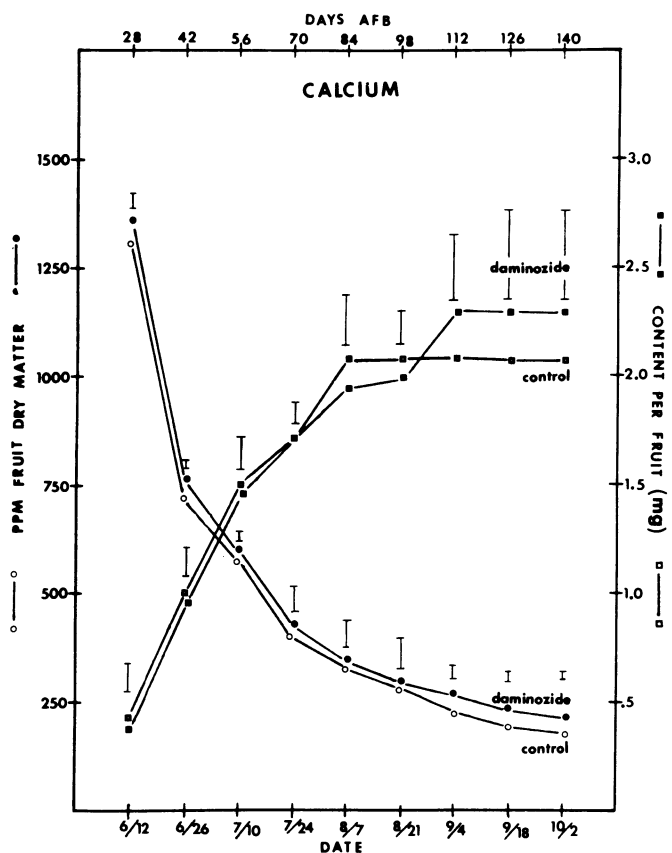


Fig. 2. Conc'n and total content of Ca in control and daminozide-treated fruit during the growing season. Vertical bar is LSD 5% level among treatments.

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Yield and Maturity of 'Concord' Grapes following Spring Frost¹

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Abstract. Severe frost injury was incurred about full swell on one group and about 4th leaf on another group of 'Concord' (*Vitis labrusca* L.) vines where sprinkling was interrupted during the night. The wet tissues were less cold resistant than dry tissues. Yield was reduced 22% by the early frost, 52% by the later frost. Bloom was delayed 10 days by the early frost, 18 days by the later frost. At harvest the berries were larger than non-frosted on the early-frosted vines and equal in size on the late-frosted vines. Color and soluble solids were lower on the frosted vines.

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A severe spring frost may kill every growing shoot on grape vines. Unlike tree fruit species, however, the vine bears dormant buds that are fruitful and can produce a partial crop (1, 3, 4, 7, 8). Such buds include secondary buds in the compound buds which produced the frozen primary shoots, basal primary buds that had not started growth, and latent buds from previous seasons (3). The reduction in crop