either "fruit" or "leaf" applications of ethephon, but the normal dilute application to both fruit and leaves resulted in accelerated softening. Both fenoprop and ethephon have been reported to soften fruit (1, 2). It would appear that the drastic softening noted here is the result of a combined effect of both ethephon and the high fenoprop concn, but only when both fruit and leaves received an application of these materials. It may be that fenoprop is leaf absorbed while ethephon is fruit absorbed resulting in a combined influence on the fruit which results in substantial softening. Other studies conducted in conjunction with this work indicate that the level of softening could be substantially reduced if the fenoprop concn was reduced to 10 ppm (data not shown).

In practical usage, the color response to ethephon would be the limiting factor. To maximize this response, ethephon and fenoprop should be applied as a dilute spray, using sufficient water to cover all fruit on the tree as thoroughly as possible.

Effect of Preharvest Application of Gibberellic Acid (GA3) on Storage Breakdown of Apples

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Abstract. Preharvest application of GA3 to 'Jonathan' apples by spraying reduced the incidence of storage breakdown when it was applied close to harvest but it was ineffective with earlier application.

The incidence of low temperature breakdown in 'Jonathan' apples can be reduced by injecting or dipping fruit with GA3 after harvest (1, 2). We have examined the effect of preharvest application of GA3 on breakdown during subsequent cool storage.

Mature 'Jonathan' trees on 'Northern Spy' rootstocks were used for each study. Trees were divided into 4 sections and GA3 was applied to 3 sections at different times, the remaining section was left untreated. GA3 was applied as a spray containing 400 ppm of Grocel5, a water soluble form of GA3. The incidence of breakdown in each treatment was determined by storing 25 mature fruit of uniform size at -1°C until similar fruit developed breakdown. Fruits were examined after a further holding period of 7 days at 20°C.

The effect of GA3 on breakdown was dependent on when the chemical was applied (Table 1). GA3 reduced breakdown when applied close to harvest but became increasingly ineffective when applied earlier. The extent of the reduction in breakdown may be related to the level of GA3 in the fruit at harvest. GA3 that was applied well before harvest may have been substantially inactivated at harvest.

CO2 is used in controlled atmosphere storage to prolong the post harvest life of fruit. The action of CO2 in fruit including Bartlett pear, was attributed to the modulation of aerobic respiration (8). The sparing of succinic and isocitric acids accompanying CO2 application to pear (9) suggests that CO2 may influence the activity of mitochondrial enzymes, including succinic dehydrogenase (SDH), involved in the turnover of respiratory substrate. This report presents preliminary results showing a decrease in the activity of SDH, following CO2 application to "Bartlett" pear during cold storage.

Fruits were harvested at the mature green stage, corresponding to firmness of low temperature breakdown in apples with gibberellic acid.

Literature Cited

Table 1. Effect of preharvest spray application of GA3 on breakdown in cool stored 'Jonathan' apples.

<table>
<thead>
<tr>
<th>Year</th>
<th>Time of GA3 application</th>
<th>Breakdown (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>1 day before harvest</td>
<td>24 a</td>
</tr>
<tr>
<td></td>
<td>4 weeks before harvest</td>
<td>43 b</td>
</tr>
<tr>
<td></td>
<td>11 weeks before harvest</td>
<td>64 c</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>56 bc</td>
</tr>
<tr>
<td>1972</td>
<td>1 day before harvest</td>
<td>41 a</td>
</tr>
<tr>
<td></td>
<td>1 weeks before harvest</td>
<td>51 ab</td>
</tr>
<tr>
<td></td>
<td>2 weeks before harvest</td>
<td>60 b</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>58 b</td>
</tr>
</tbody>
</table>

1There were twelve replicate trees in 1971 and 24 in 1972.
2Mean separation (within years) by 't' test, 5% level test performed on data transformed to angles.

To obtain maximum benefit from GA3, its use before harvest would appear to be limited as it is not always practical or convenient to spray all fruit immediately before harvest. As many cultivars are now dipped immediately after harvest to control superficial scald and rots in storage, postharvest application would probably be a more suitable method of using GA3 to reduce breakdown.

Effect of Carbon Dioxide on Activity of Succinic Dehydrogenase in 'Bartlett' Pears During Cold Storage

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Abstract. 'Bartlett' pears (Pyrus communis L.) were kept in cold storage in air, and at CO2 concentrations of 5, 10, 15, and 20%. The mitochondrial fraction from the fruit pulp was extracted periodicaly, made into acetone powder and assayed for activity of succinic dehydrogenase. Progressive decreases in activity of the enzyme were observed with increases in CO2 concentration in the storage atmosphere.

CO2 is used in controlled atmosphere storage to prolong the post harvest life of fruit. The action of CO2 in fruit including Bartlett pear, was attributed to the modulation of aerobic respiration (8). The sparing of succinic and isocitric acids accompanying CO2 application to pear (9) suggests that CO2 may influence the activity of mitochondrial enzymes, including succinic dehydrogenase (SDH), involved in the turnover of respiratory substrate. This report presents preliminary results showing a decrease in the activity of SDH, following CO2 application to "Bartlett" pear during cold storage.

Fruits were harvested at the mature green stage, corresponding to firmness of low temperature breakdown in apples with gibberellic acid.
value of 8.5 kg and kept at 0°C in air and 5, 10, 15, and 20% CO₂. The fruit pulp was sampled periodically for SDH activity. Each treatment (120 fruits) was kept in 100-liter metal containers. The applied gas mixtures were administered to the fruit at a flow rate of 14-16 liter/hr. The O₂ concn in the gas mixtures used was kept at no less than 15% to avoid conditions of anoxia in the fruit. The composition of the gas was verified periodically using a previously described method (2) with a Model 29 Fisher-Hamilton Gas Partitioner. Combined tissue samples representing 30 fruit from each gas treatment, weighing approx. 200 g, were used at 0, 30, 61, 92 and 118 days of storage for extraction and preparation of a mitochondrial acetone powder using a method by Hiatt (4). The powder was used for the assay of SDH following Ell's method (3). An acetone powder homogenate was prepared in the presence of 100 mM phosphate buffer, pH 7.5, in an ice-chilled glass homogenizer for 6 min. Five ml of the homogenate containing 3 to 4 mg powder, corresponding to 0.5 to 0.8 mg of protein, were combined with 5 ml reaction medium consisting of 100 mM potassium phosphate buffer, pH 7.5, 20 mM KCN, 0.06 mM 2,6-dichlorophenolindophenol, and 0.6 mg/ml of N-methylphenazinium sulfate. The activity of SDH was initiated at room temp by the addition of 1 ml of 80 mM sodium succinate. Enzyme activity was measured as the change in O.D. at 600 nm using a Bausch & Lomb Spectronic 20, at 30 sec intervals for 2 min. The change in O.D. was linear and first order under the assay conditions using 1 to 10 mg powder. The activity of SDH was expressed as specific activity and was defined as the change in O.D. per 30 sec, per 0.1 mg protein. Protein concn in the assayed samples was determined by Lowry's method (6) using crystalline bovine serum albumin as a standard.

The specific activity of SDH in fruit kept in air showed a steady increase with a maximum at 60 days of storage, and a decline afterward (Fig. 1). The activity of SDH decreased in proportion to the employed CO₂ concn in the storage atmosphere. The effect of CO₂ on SDH in pear is compatible with other observations showing CO₂ inhibition of SDH and other mitochondrial enzymes in Ricianus (1, 7) and apple (5). The decrease in SDH activity corresponds also to the decrease in the respiratory activity in pear, following the application of CO₂ (8) presumably as a consequence of inhibiting the activity of mitochondrial enzymes.

The assayed fractions, however, were not adequately defined to warrant the conclusion that CO₂ affects specifically the activity of mitochondrial SDH. Further studies are needed to relate the mode of CO₂ action to mitochondrial enzymes, including SDH.

**Literature Cited**


**Benomyl Protection of Grapevines from Air Pollution Injury¹**

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**Abstract.** *Methyl 1-buty1-carbomoyl-2-benzimidazole carbamate* (benomyl) as a dilute foliar spray reduced atmospheric oxidant injury (oxidant stipple) on 'Ives' and 'Concord' grapevines (*Vitis labrusca* L.) in a vineyard experiment in 1972. Three to 7 multiple applications at 1.12, 3.36, and 6.72 kg/ha increased the protection over unsprayed 'Concord' vines. Single and double applications were ineffective. The degree of protection afforded was directly related to the frequency of benomyl application.

Evidence for ozone (O₃) injury (oxidant stipple) to sensitive cultivars of grapevines in New York State has been reported (4) and found to be widespread in grape growing regions near the Great Lakes. Until emission of air pollutants can be controlled, methods of protecting grape foliage deserve attention.

Several chemicals, including a number of fungicides, have been shown to afford various degrees of protection against oxidant induced plant damage (1, 3, 5). Benomyl, a systemic fungicide, has demonstrated particular promise in ameliorating O₃ injury when applied as a foliar spray to tobacco plants (3, 5). The objectives of this study were to determine the effectiveness of benomyl...