Effect of Aminoethoxy Analog of Rhizobitoxine on Ripening of Pears

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ABSTRACT

Ripening reactions in pears (Pyrus communis L.) were differentially affected by an aminoethoxy analog of rhizobitoxine (L-2-amino-4-[2-aminoethoxy]-trans-3-butenolic acid) (AAR). Ethylene production of both 'Anjou' and 'Bartlett' pears was inhibited by AAR. Decrease in firmness, increase in protein N and soluble pectin were delayed by AAR in 'Anjou' but not in 'Bartlett' pears. While loss in malic acid was retarded in 'Anjou' pears, rates of citric acid accumulation and malic acid reduction were not affected by AAR in 'Bartlett' pears.

Fig. 1. Effect of aminoethoxy analog of rhizobitoxine on ethylene production and firmness of 'Bartlett' pears. Vertical bar is LSD .05 among treatments.

were treated with 1000 ppm of aminoethoxy analog of rhizobitoxine (L-2-amino-4-[2-aminoethoxy]-trans-3-butenolic acid) by 3-min dipping or by vacuum infiltration (5). Control fruits were similarly treated with distilled H2O. After treatment, the fruit remained at 20 C for ripening.

Ethylene production was measured daily at 20 C. Organic acid, protein N, soluble pectin, and firmness were determined before the treatment and then at 2-day intervals thereafter. Methods for these analyses and determinations were described previously (19).

RESULTS

A varietal difference and an independent response of various individual ripening reactions were shown by the treatment with AAR.1 The magnitude and rate of ethylene production in 'Bartlett' pears were suppressed but softening was not affected by AAR (Fig. 1). The vacuum infiltration method was slightly more effective than the dipping method in inhibiting ethylene production, but 'Bartlett' pears treated by both methods softened at the

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3 Abbreviation: AAR: L-2-amino-4-[2-aminoethoxy]-trans-3-butenolic acid.
The level of ethylene production in 'Bartlett' pears was delayed by AAR treatment (Fig. 2). Inhibition by AAR was much greater on ethylene production than on other parameters of ripening in both varieties of pears.

**DISCUSSION**

These results indicated that various individual ripening processes were affected differently by AAR treatment and each process reacted independently. The experiments also demonstrated the differences between the ripening response of 'Anjou', a long keep and slow ripening winter pear, and 'Bartlett', a short lived and fast ripening pear, as affected by AAR.

Rhizobitoxine was shown to be an inhibitor of β-cystathionase, an enzyme in the pathway of methionine biosynthesis in higher plants (6). Because the inhibition of ethylene synthesis...
cannot be relieved by added methionine, Lieberman and co-workers (10, 13) concluded that rhizobitoxine interfered with ethylene biosynthesis by blocking the conversion of methionine to ethylene and that the inhibition is nonreversible. As high as 99% of the ethylene evolution in aging rib segments of morning-glory flowers was inhibited by AAR (8). Since ethylene production in pears was greatly inhibited by AAR and since AAR is thought to be a specific inhibitor of ethylene synthesis in the methionine pathway (10), this study also showed that methionine is the major, if not the only, source of ethylene during ripening in pears.

Many changes occur during ripening along with the increase in ethylene synthesis. Dependency of these reactions on ethylene is unclear because it is very difficult to remove ethylene without concomitant inhibition of these reactions. As specific inhibitors of ethylene synthesis from methionine, rhizobitoxine and its analogs offer a good opportunity to study the behavior of these processes in the absence of ethylene.

Increasing evidence (1, 4, 12, 18) demonstrates that these different individual processes occur more or less at the same time during ripening but independently of one another. The climacteric rise in respiration may represent merely a collective result for energy requirement and may not be a phenomenon closely associated with ripening in fruit (9, 15, 16, 21). Separation of the various individual processes would help to clarify mechanisms involved in fruit ripening. The differential effects on ethylene production and other ripening events in pears by treatment with AAR in this study indicate that there were differences in the sensitivity of various reactions to ethylene and ethylene inhibitors. Treatment with AAR did not exert the same degree of inhibition on various ripening reactions. The differential responses to this inhibitor suggest that these processes can proceed separately and independently. Better manipulation of ripening quality may be possible by retardation of certain undesirable processes and promotion of other desirable reactions.

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LITERATURE CITED

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Fig. 6. Effect of aminoethoxy analog of rhizobitoxine on soluble pectin of 'Anjou' pears. Vertical bar is LSD .05 among treatments.

Fig. 7. Effect of aminoethoxy analog of rhizobitoxine on protein N of 'Anjou' pears. Vertical bar is LSD .05 among treatments.

Fig. 8. Effect of aminoethoxy analog of rhizobitoxine on malic acid of 'Anjou' pears. Vertical bar is LSD .05 among treatments.