Identification of Abscisic Acid in Bartlett Pears and Its Relationship to Premature Ripening

A growth inhibitor in Bartlett pear was identified as abscisic acid (ABA) by paper chromatography, ultraviolet spectrometry, and gas-liquid chromatography. Fruit from limb enclosures kept at 16-24°C showed only a slight increase in the amount of ABA. Premature ripening and greater accumulation of ABA was found in fruit from branches kept at 7-18°C during 30-day preharvest period.

EXPERIMENTAL

The experiments were initiated 30 days prior to the estimated harvest date. Installation of Mylar covered limb enclosures and methods of temperature control were described previously (Wang et al., 1971). Cooled cages were maintained at 18°C during the day and at 7°C during the night. Temperatures in the heated cages were maintained at 24°C daytime and 16°C at night. The first samples were collected 10 days after start of the experiment.

Exposure of Bartlett pears to abnormally cool temperature for short periods prior to harvest causes an early development and acceleration of the biochemical and physiological changes normally associated with maturation and ripening (Wang et al., 1971). As a result, ripening is initiated and develops on the tree prior to anticipated time of normal harvest. While the nature of this physiological disorder is not fully understood, the level or ratio of certain growth substances within the fruit may be involved in stimulation of ethylene production and development of ripening capacity (Dilley, 1969).

Abscisic acid (ABA), known to stimulate fruit ripening (Addicott and Lyon, 1969), occurs in unripe Clapp's Favourite pears and increases in concentration during ripening (Rudnicki et al., 1968). The present study was initiated to determine if ABA also occurs in the Bartlett pear cultivar and if significant changes in concentration develop during cold-induced premature ripening.

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LITERATURE CITED

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The eluate was scanned spectrophotometrically.

Inhibitory activity was cut and eluted with 95% ethanol.

Paper chromatography, twice in 2-propanol: ammonia (8:1 v/v/v). The methylsilyl derivatives to provide an improved separation of the peak for the trimethylsilyl derivatives.

The solutions of ABA standards (0.078-2.5 µg) and of the fruit extract were separately streaked on Whatman No. 1 paper and chromatographed with five different solvents (2-propanol:ammonia:water 8:1:1 v/v/v, benzene:ethyl acetate:formic acid 80:20:5 v/v/v, chloroform:benzene:acetic acid 100:100:1 v/v/v, ethanol:ammonia:water 80:5:15 v/v/v, 2-propanol:water 10:1 v/v/v). Each chromatogram was assayed with the oat coleoptile test. An alteration in the ratio of ABA to ripening inhibitors may also be involved (Dilley, 1969).

RESULTS

Identification of ABA in Bartlett Pears. The \( R_f \) value which showed the most inhibitory activity from the extract separated and purified by paper chromatography coincided closely with that of synthetic ABA in the five different solvent systems used. Also, the ultraviolet absorption spectra of the ethanol eluates were identical. The trimethylsilyl derivative of the inhibitor had the same retention time as that of synthetic ABA in gas-liquid chromatography.

Relationship of ABA and Premature Ripening. The amount of ABA in heated fruit was low and showed only a slight increase during the experiment (Figure 1). Fruits exposed to cool temperatures consistently had a higher ABA level. In samples harvested after 30 days of modified temperature treatment, the cooled fruit contained five times more ABA than the heated fruit and was 5 lb softer (Figure 2).

DISCUSSION

Since Okhuma et al. (1963) first isolated ABA from cotton fruits, it has been identified in extractions of numerous species (Addicott and Lyon, 1969). Fruits are found to be the richest source (Milborrow, 1967). Although its role in fruit ripening is not fully understood, an increased amount of ABA was found to accompany the ripening process of Clapp's Favourite pears (Rudnicki et al., 1968).

It has been reported that ABA stimulates ethylene production in bean explants (Abeles, 1967) and citrus leaves (Cooper et al., 1968). The high concentration of ABA which accumulated in cooled Bartlett fruits may similarly have stimulated ethylene production. While pears in the heated cages responded normally, fruits in the cooled cages showed an early acceleration in ethylene production and developed typical symptoms of premature ripening and many had abscissed (Wang et al., 1971). Cooper et al. (1969) reported an accumulation of ethylene in citrus fruits as a result of chilling. Cool temperature probably caused upsetting of the balance of endogenous growth regulators (Phinney and West, 1960) which in turn changed the normal pace of the matura-
resulted from synthesis in the fruit or was translocated from the leaves cannot be determined from the data. In detached pears, Rudnicki *et al.* (1968) found that an increase in ABA concentration occurred during storage. Therefore, cool temperature exposure may actually stimulate ABA synthesis within the fruit. It was reported, however, that ABA can be synthesized in leaves and is readily transported to other organs (Eagles and Wareing, 1964; Evans, 1966). Thus, the source of ABA in premature ripened Bartlett pears is not clear and warrants further study.

**LITERATURE CITED**


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