EFFECTS OF GROWTH REGULATING SUBSTANCES ON THE RIPENING OF DETACHED BANANA FRUITS

The ripening effects of 2,4-dichlorophenoxyacetic acid on detached banana fruits were first observed by Mitchell and Marth (1944). They found that when this compound was applied to the exterior of bananas, apples and pears, either as an aerosol or in aqueous solution, the ripening of these fruits was hastened. Bananas treated experimentally by them with this compound ripened 3–8 days sooner than untreated fruit. Ripening so induced was claimed to be extremely even. Further work by Marth and Mitchell (1949) resulted in the observation of an apparent antagonistic effect between applied growth regulating substances and naturally produced ethylene during the ripening processes. Further reference to the ability of 2,4-dichlorophenoxyacetic acid to ripen bananas is made by Marth, Audia and Mitchell (1956). Leopold (1955) suggested that in view of the results of Goldacre, Galsdon and Weintraub (1953) the ripening agent was not 2,4-dichlorophenoxyacetic acid but traces of either 2,4-dichlorophenol or 2,4-dinitrophenol present as impurities.

Experimental Details.

In Queensland, commercial ripening of bananas is done with either ethylene or coal gas applied to the fruit, at constant temperature, in small concentrations. As there is always a risk of explosion with these gases if they are not handled carefully, investigations on hormones were carried out from October 1956 to March 1957 in an endeavour to obtain an alternative method of ripening the locally grown fruit of the variety Cavendish. Fruit for experimental purposes was obtained from the local market, and in each experiment fruit was obtained equally from bunches bearing full fruit and those bearing thin, poorly filled fruit. Sample variability was obviated, as far as possible, by removing hands from each bunch and dividing them, a finger at a time, into the required number of treatments so that each treatment contained similar material.

The various growth regulating substances used were applied to the fruit in aqueous solutions or as emulsions in 15 per cent. ethanol. In all cases a commercial wetting agent was added to ensure uniform wetting of the fruit. Generally the compounds were applied by dipping the fruit into the prepared solutions or emulsions, allowing it to drip dry, and

holding it at either 68 deg. F. (the temperature found by Young, Bagster, Hicks and Huelin (1932) to be the most satisfactory for the ripening of this fruit) or at atmospheric temperatures. In one experiment, the ethyl ester of 2,4-dichlorophenoxyacetic acid was evaporated on a hotplate and the fruit exposed to a concentration of its vapour of 200 p.p.m. for 24 hours in an airtight chamber. Severe skin damage resulted and this method of application was discontinued.

Evaluation of the ripening effect was made by classifying individual fruits according to skin colour and/or firmness of flesh. Firmness was measured by means of a Magness Penetrometer fitted with a $\frac{7}{16}$ in. plunger. One inch was cut from each end of the fruit to be tested and pressure applied to the cut end until the plunger sank to the marked line.

The following growth regulating substances, generally commercial samples, were used in the investigations:—

(1) 2,4-dichlorophenoxyacetic acid.

(2) 2,4-dichlorophenoxyacetic acid (sodium salt).

(3) 2,4-dichlorophenoxyacetic acid (ethyl ester).

(4) 2,4-dichlorophenoxyacetic acid (triethanolamine salt).

(5) 2,4,5-trichlorophenoxyacetic acid (butyl ester).

(6) 2,4-dichlorophenol.

(7) 2,4-dinitrophenol.

(8) 2,4,5-trichlorophenoxypropionic acid.

(9) 2 methyl 4 chlorophenoxyacetic acid (sodium salt).

(10) 2 methyl 4 chlorophenoxyacetic acid (amine salt).

(11) Chloroisopropylphenylcarbamate.

(12) Naphthalene acetic acid.

(13) Parachlorophenoxyacetic acid (sodium salt).

(14) Maleic hydrazide.

Results.

The results were difficult to interpret because of the extreme variability of the materials used. However, it was apparent that some growth regulating substances have a decided influence on the ripening of some

banana fruits. The samples of 2,4-dichlorophenoxyacetic acid, 2 methyl 4 chlorophenoxyacetic acid, and their derivatives, were most effective at concentrations between 200 and 400 p.p.m. but at higher concentrations caused skin damage, the severity of which increased with concentration. Even at concentrations of 200–400 p.p.m., the ethyl ester of 2,4-dichlorophenoxyacetic acid and the butyl ester of 2,4,5-trichlorophenoxyacetic acid caused severe skin damage.

When skin damage did not develop and ripening was accelerated, a satisfactory skin colour failed to appear. The pulp of the fruits was quite soft, as in normal ripening, but the skin retained some of its green pigmentation. Ripe fruit was a blotchy greenish yellow in colour, with some yellowish green areas.

Under commercial ripening conditions ethylene results in very even ripening with little difference between bunches whether they are poorly filled or well filled. Occasionally some fruit is hard to ripen, but as a general rule four days at 68 deg. F. with regular gassing with 1 part per 1,000 of ethylene results in complete and even ripening. Treatment with 2,4-dichlorophenoxyacetic acid, 2 methyl 4 chlorophenoxyacetic acid, and their derivatives, resulted in fruit held at 68 deg. F. ripening in 10–14 days. The resultant ripening, however, was very uneven, individual fruits in a sample often remaining quite hard and green while others were full eating ripe. This phenomenon has also been observed with untreated fruit, but the number of ripe fruit where a sample has been treated is usually greater than where the growth regulating substances have not been used.

In the experiments with 2,4-dichlorophenol and chloroisopropylphenylcarbamate, the treated fruit was consistently less ripe than the other fruit, including the untreated controls. These compounds may be of some value in retarding the ripening rates of bananas during storage and transport. The remaining compounds had no visible ripening effect on bananas in any of the experiments conducted.

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