EFFECT OF 2,4–DICHLOROPHENOXY ACETIC ACID ON THE RIPENING OF BARTLETT PEARS[1]

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(WITH ONE FIGURE)

It has long been known that ethylene and certain other unsaturated hydrocarbon gases have the property of stimulating the ripening of various fruits. Recent data indicate that similar effects can be produced by several of the synthetic plant-growth hormones. Thus, the maturation and ripening of certain varieties of apples and pears have been observed to be directly influenced by naphthalene acetic acid when used as a spray to retard harvest-drop (**1, 2**). MITCHELL and MARTH (**6**) found that the time required for the ripening of green bananas and freshly-harvested apples and pears was reduced by treatment with 2,4-dichlorophenoxy acetic acid. These treatments were applied to fruits in the pre-climacteric stage when the quantity of ethylene metabolized by the tissues is known to be extremely small (**4, 5**). No data are available to indicate their effect in the presence of physiologically active quantities of ethylene, such as occur in post-mature and storage fruits. In the present study, the comparative effects of 2,4-dichlorophenoxy acetic acid on the respiration and ripening of Bartlett pears, which vary in stage of maturity and capacity for ethylene production, are considered.

Materials and methods

Two collections of pears were made from a single tree located at the Experiment Station orchard near Corvallis. The first sample was picked on August 14 and represented fruit in an immature stage of development. The second sample was collected two weeks later when the fruit was at the optimum stage of maturity for commercial use. A portion of this collection was stored at 31° F. for five weeks prior to treatment.

The method used in treating pears with 2,4-dichlorophenoxy acetic acid consisted of immersing the fruit in an aqueous solution containing 1000 p.p.m. of the reagent and one per cent. Carbowax. In some experiments other dilutions were used as indicated later. The treated fruits were allowed to dry before transferring to the respiration chambers.

The rates of carbon dioxide and ethylene production were determined by the methods described previously (**3**).

Results and discussion

IMMATURE FRUIT

Immediately after picking, the pears were divided into four uniform lots, each consisting of 15 fruits. Lot 1 was treated with 2,4–D and then con-

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fined in a desiccator in order to retain the ethylene emanating from the fruit. Lot 2 was untreated but similarly confined during the course of the experi-

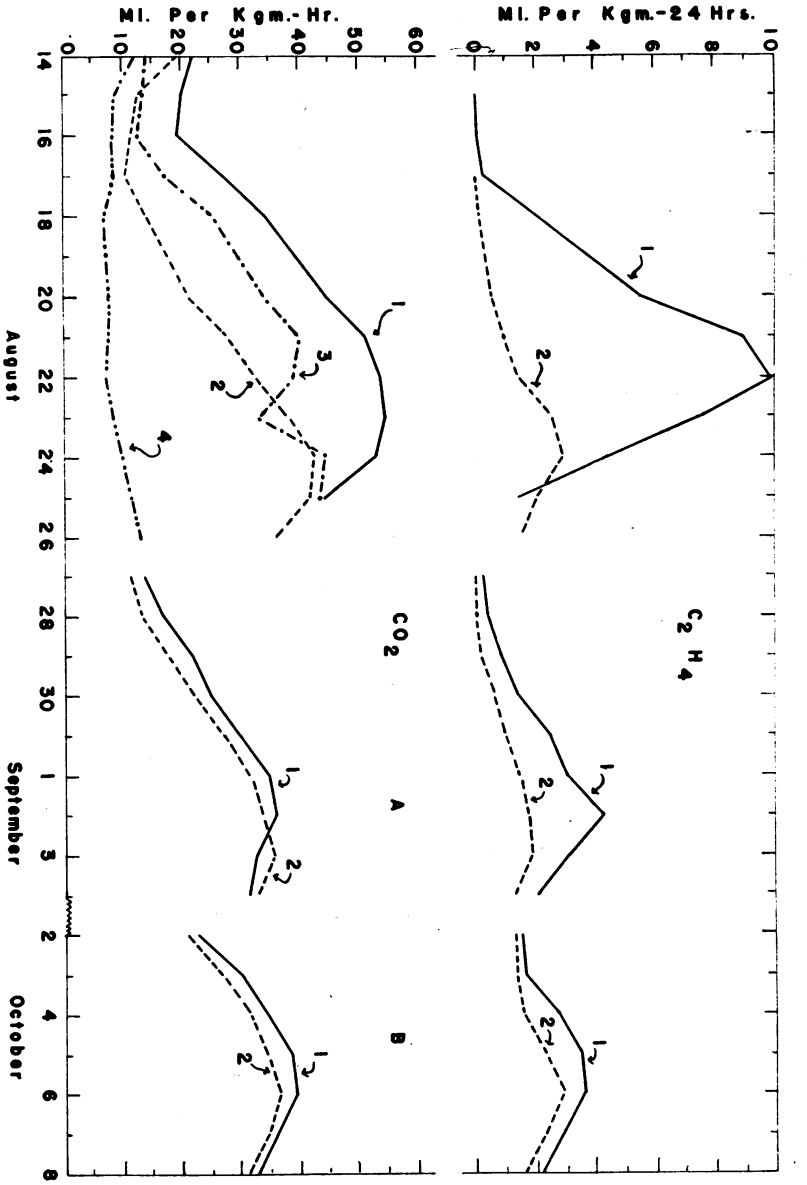

FIG. 1. Effect of 2,4-dichlorophenoxy acetic acid on the respiration and ethylene production of Bartlett pears. 1, treated-unaerated; 2, untreated-unaerated; 3, treated-aerated; 4, untreated-aerated. A, mature fruit ripened before storage; B, mature fruit ripened after 5 weeks' storage.

ment. Lot 3 was treated with the acid, then placed in a desiccator which was aerated with a constant flow of fresh air (20 liters per hour) in order

to remove ethylene from the storage atmosphere. Lot 4 was untreated and constantly aerated. The rates of carbon dioxide production were determined daily on all lots, while ethylene determinations were made only on fruit kept in the closed containers.

The amount of ethylene produced by the immature pears at the beginning of the experiment (fig. 1) was below the chemically determinable minimum, and when constant aeration was provided, as in Lot 4, the fruit remained in the preclimacteric stage and failed to ripen during the course of the experiment. When ethylene was allowed to accumulate in the storage atmosphere, as in Lot 2, respiratory activity increased and the fruit was fully ripe at the peak of the climacteric. Similar stimulation occurred in the samples treated with 2,4–D. The treated fruit, which was unaerated (Lot 1), however, attained a higher maximum rate of respiration and ripened one day sooner than the treated fruit, which was aerated (Lot 3). These data indicate that 2,4–D and ethylene in combination have a greater influence on respiration and ripening than either reagent has when used separately.

Treatment with 2,4–D greatly increased the rate of ethylene formation by the fruit. In the treated sample, ethylene production attained a maximum value of 10.06 ml. as compared to 2.84 ml. per kilogram per 24 hours in the untreated fruit. This represents a 3.6-fold increase due to treatment, and since there was only a 1.3-fold increase in rate of respiration in the same fruit, the production of ethylene and carbon dioxide do not appear to have been equally influenced by 2,4–D.

Mature fruit

The rates of ethylene and carbon dioxide production were determined on treated and untreated pears before and after five weeks' storage at 31° F. In addition, the rates of ripening were determined on separate lots of fruit which were treated with 2,4–D in concentrations of 10, 50, 100, 250, 500 and 1000 p.p.m. then kept in well-ventilated room maintained at a temperature of 65–70° F.

The initial rate of ethylene production in the mature pears before storage was less than 0.001 ml. per kilogram per 24 hours, and during ripening increased to 1.86 ml. and 4.31 ml. in the untreated and treated lots, respectively (fig. 1). There was very little difference in the rate of respiration between the two lots, although the peak of the climacteric occurred one day sooner in the treated fruit. As indicated by pressure tests, all lots of fruit treated with 2,4–D in concentrations of 50 p.p.m. and higher ripened in seven days, while the untreated lot ripened in nine days. The green color of the fruit treated with the acid in concentrations of 100 p.p.m. and higher failed to disappear uniformly, resulting in the development of a yellow-green, mottled appearance. This condition was not evident on fruit treated only with one per cent. Carbowax, nor in fruit treated with 2,4–D after five weeks of cold storage.

The pears which had been kept in cold storage for five weeks were still

firm and green and differed but little in outward appearance from freshly-harvested fruit. The data show, however, that the respiratory activity and the capacity for ethylene production were much greater than before storage, and it is evident that the climacteric was in progress at time of treatment. Both carbon dioxide and ethylene production tended to be slightly higher in the treated fruit, but the peak of the climacteric in both treated and untreated lots occurred on the same day. All lots of fruit, including the controls as well as those treated with varying concentrations of 2,4–D were fully ripe on the sixth day. According to these data, the time required for the ripening of Bartlett pears is unaffected by 2,4-dichlorophenoxy acetic acid when treatment is applied after the climacteric has been initiated.

Summary

Aqueous solutions of 2,4-dichlorophenoxy acetic acid in 1 per cent. Carbowax were applied to Bartlett pears at different stages of maturity and their effect on ripening, respiration and ethylene production determined.

Treatment of premature pears resulted in an increase in the rates of ripening, respiration, and ethylene production. The maximum values for carbon dioxide and ethylene production were 1.3 and 3.6 times greater, respectively, in the treated than in the untreated fruits. Ethylene and 2,4-dichlorophenoxy acetic acid in combination appeared to have a greater effect on ripening, respiration and ethylene production than either reagent used separately.

Mature pears treated shortly after harvest showed higher rates of respiration and ethylene production and ripened two days sooner than similar untreated fruit. The time required for the ripening of mature pears which had been stored at 31° F. for five weeks was not reduced by treatment with 2,4-dichlorophenoxy acetic acid. The rates of carbon dioxide and ethylene production, however, tended to be higher in the treated fruits.

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